Final Solar Systems Monitoring Report 1985

Ministry of Energy
Ontario

Honourable
Vincent G. Kerrio
Minister

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FINAL SOLAR SYSTEMS MONITORING REPORT

1985

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ONTARIO MINISTRY OF ENERGY
ACTIVE SOLAR MONITORING PROJECT

EXECUTIVE SUMMARY

The Active Solar Monitoring Project was conducted by the Ministry of Energy of the Province of Ontario, Canada, between November, 1982, and October, 1985. The objective of the project was to instrument, monitor, assess, and report on the energy performance and reliability of the solar energy demonstration projects sponsored by the Ministry. The monitoring project was an essential part of Ontario's Solar Energy Program, which included over 190 solar heating demonstration projects, and 2 photovoltaic demonstration projects. These were located on government buildings, and on commercial, industrial, municipal, institutional, and religious buildings. The solar energy systems on some of these buildings, and their monitoring activities, were sponsored jointly by the Ministry of Energy, and Energy, Mines, and Resources Canada.

Purpose

This project was initiated in order to obtain information about the real performance of solar energy systems in Ontario. How much useful energy does each system produce? Which systems produce the most energy, per square meter of collector area, per year? What are the maintenance costs of each solar energy system? Is each system performing reliably? How does real system performance compare with computer predictions? The answers to these questions are essential to anyone planning for the future widespread commercial use of solar energy systems.

These questions have been answered by the Monitoring Project, and the objectives of the project have been met.

The initial planning of the project benefitted from previous studies, which described the successes and failures of previous monitoring projects. The opportunity to monitor a large number of solar energy systems with increasingly versatile and complex equipment is bounded by many constraints, including the following: capital cost of installed monitoring equipment; annual operating costs; availability of skilled manpower on schedule; availalability of equipment on schedule; ease of installation of equipment; reliability of equipment; accessibility of the sites; complexity of collected data; requirement for expert observation on site; availability of committed future funds.

Scope of the Project

The total budget for the three year Active Solar Monitoring Project was $870,000 (Cdn.) for the monitoring contractor and sub-contractors, and approximately $210,000 (Cdn.) for equipment. During the course of the project, 107 solar energy systems were instrumented, monitored, and reported, although not all at the same time. The annual budgets for the monitoring contractor facilitated some flexibility in the monitoring activities, and overcame the uncertainties of budget forecasting

The monitored data from the solar energy projects are presented in this final report, and in similar annual reports from the previous two years. Specific information about individual solar energy systems is available in the monthly solar monitoring reports, which are compiled with each annual report.

Monitoring Philosophy

An analysis of the requirements, resources, and constraints produced a "low level" monitoring philosophy. The basic principles of the low level philosophy are the following:

(1)
The monitoring problem is basically a management problem, rather than a technology problem. Opportunities for exotic new technology should be treated with caution.

(2)
The monitoring function should be performed by an independent, expert, impartial monitoring contractor, and not by the building owners or the solar energy system suppliers, who lack the necessary impartiality, and may lack the necessary skills. The monitoring instruments should be completely separate from the solar energy control system, and from any public display panels. The monitoring contractor should not become involved in repairs or maintenance of solar heating systems.

(3)
The project should begin on a small scale, with instrumentation and monitoring at a few small sites, before any attempt is made to monitor a large number of sites.

(4)
Site visits by the monitoring contractor are at least as important as instrument readings. These visits should be used to record important qualitative observations, and to record quantitative data from simple instruments.

(5)
Electronic instruments, e.g. energy meters, should be backed up by simple instruments, e.g. thermometers, mechanical flow meters.

(6)
Standardized, monthly reports should be sent to the building owners, the solar energy system contractors, and other interested parties. These monthly reports can be used for prompt correction of reported problems.

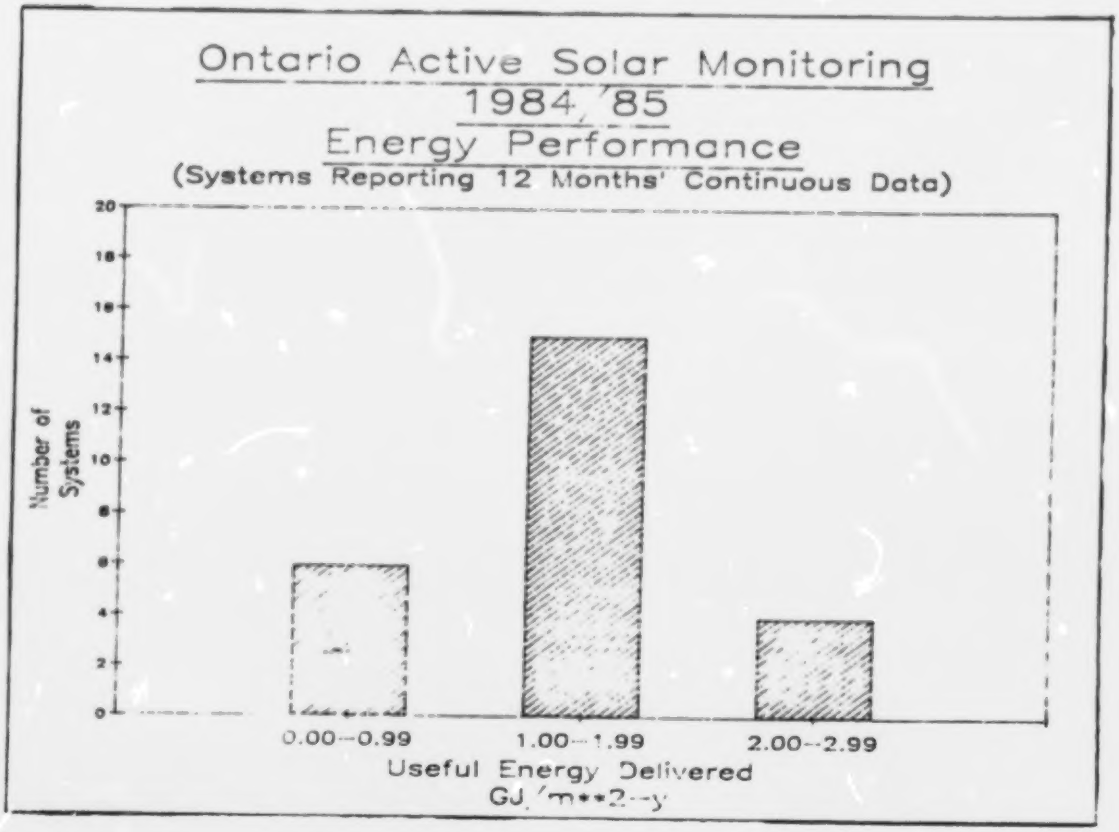
(7)
The solar energy systems are not uniform. Thus, instrument systems cannot be completely uniform. The variations in instrument systems and types of recorded data, from site to site, should be recorded in the monthly reports.

(8)
At this level of funding and manpower, flawless data should not be expected. Nevertheless, a great deal of useful information can be reported, and can meet the original objectives of the project.

Computer Monitoring

After the above statement of the basic principles of low level monitoring, it should be mentioned that some departures from these basic principles did occur.

In particular, five microprocessor-based digital data acquisition systems, which exceeded the original concept of low level instruments, were installed at five large solar heating systems. All five of these digital data acquisition systems collect hourly data from a large number of sensors. The data has been useful in verifying computer predictions of system performance. These five systems should prove to be valuable during the next several years, because their stored data can be accessed by telephone, directly from the Ministry of Energy. Their installed cost was approximately $25,000 (Canadian) per system, not including flow meters. The five systems required approximately 15 months from concept to completion.



Conclusions

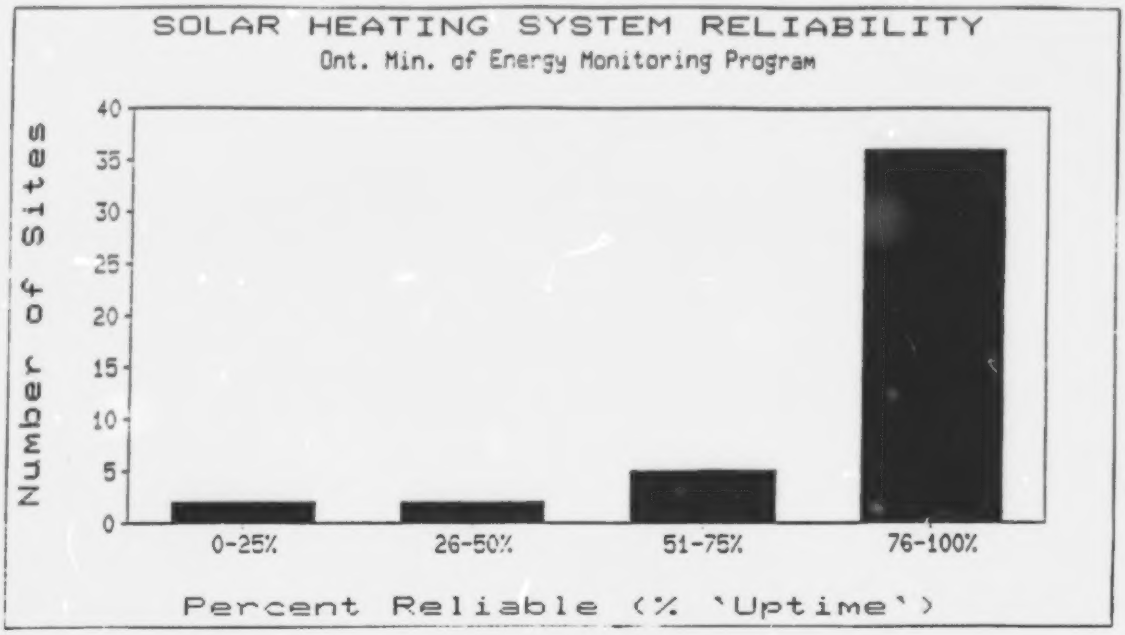
This project has produced the following important conclusions:

(1)
A typical well designed, built, and operated solar heating system in Ontario produces between one and two gigajoules of useful energy per square meter of solar collector area per year. The graph on the previous page shows the distribution of useful delivered energy per square meter for 25 solar heating systems monitored in this project during 1984/85.

The maximum useful energy from a solar heating system, monitored in Ontario, was close to 2.7 gigajoules per square meter per year. Well designed, built, and operated, such a system is in an ideal situation, providing heat at a low temperature, for preheating service hot water, to meet a high daytime load, 365 days per year.

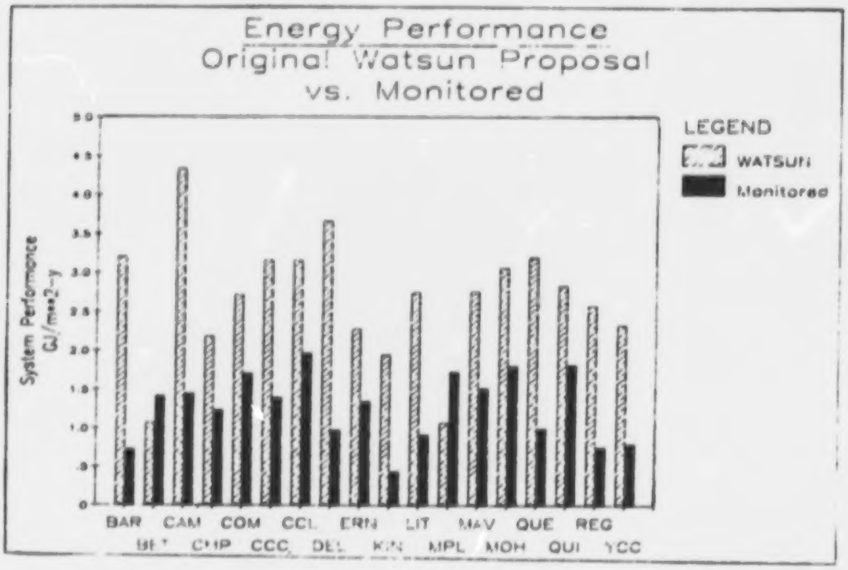
(2)
Maintenance costs per year for a well designed, installed, and operated solar heating system in Ontario are approximately one percent of the capital cost. These costs are, of course, higher for a system with reliability problems.

(3)
Although most of the solar heating systems in the Ontario program are now performing reliably, an unacceptably large number still have problems. The reliability graph for 1984/85 shows that, of 45 systems monitored, only 35 were operating during more than 76% of the days of the year. The two photovoltaic systems monitored in this project both performed reliably.



(4)
The standard computer programs, F-CHART and WATSUN, appear to be an acceptably accurate method of predicting the performance of a solar heating system, provided that the system resembles the computer model, and the input data is realistic. Section 5.0 of this Final Report, and Section 4.9 of the 1984 Annual Report, show the good correlation which can be obtained between these two computer prediction programs and monitored data.

However, the real total useful annual energy produced by a solar heating system tends to be much less than the original predictions at the project approval stage, which tend to use over-optimistic input data in standard performance prediction computer programs.The following graph shows this difference for 18 systems which were monitored in 1984/85, for which WATSUN computer predictions had been submitted at the proposal stage:



BAR---Barrymore Carpets
CAM---Cameron Hts.Sw.Pool
COM---Comfort Living Apts.
CCL---Country Clean Laundry
ERN---Erin Mills Lodge
LIT---Little's Nursing Home
MAV---Mavis Rd.Car Wash
QUE---Queens Univ. Gym
REG---Regency Racquets Club

BET---Bethesda Home
CMP---Campbell Soup
CCC---Country Clean Car Wash
DEL---Deluzio Car Wash
KIN---Kincardine Sw.Pool
MPL---Mapleview Lodge
MOH---Mohawk Hosp. Svces.
QUI---Quick Clean Laundromat
YCC---York Condo. 340

In future projects, monitoring of real site data, especially hot water load, in litres per hour, should be completed before prediction of solar performance is attempted.

Acknowledgement
In conclusion, the Ministry wishes to thank the Active Solar Monitoring Contractor, G.K.Fleming and Associates Ltd., of Thunder Bay, Ontario, for excellent work in this project.

Disclaimer

This report, prepared for the Ontario Ministry of Energy, is published as a public service for the information of the public. The Ministry does not, however, warrant the accuracy of its contents and cannot guarantee or assume any liability for the effectiveness or economic benefits of the devices and processes described in the report.

2.0 Introduction

G. K. Fleming and Associates Limited has been responsible for monitoring, instrumenting and reporting upon one hundred and twelve solar sites throughout Ontario for the past thirty-six months. For the past twelve months, forty-five sites have been monitored and reported upon. During this period thirteen new sites have been instrumented and monitoring has been discontinued at eighteen sites.

In most cases monitoring consists of measuring solar energy delivered and auxiliary energy delivered. There are several exceptions to this as described below:

1. In certain applications it is impractical to measure auxiliary energy so only solar energy is monitored. In some of these installations where service hot water loads are being monitored, the litres per month total demands are monitored.
2. In several sites solar insolation and solar energy collected are measured.
3. In five instrumented sites high-level monitoring is performed involving hourly measurements of approximately ten temperatures and several flows.
4. The type and location of instruments varies from site to site. The individual monthly solar monitoring report is the best guide to a specific instrument installation.

This report contains a list of sites whose instrumentation has been removed as well as a list of sites instrumented during the twelve month period covered by this report.

An attempt is made in this report to compare actual and predicted solar energies delivered and a general discussion explores the reasons for poor performance in some of the solar energy systems.

High-level monitoring has been installed on five system. In two cases a full twelve month set of readings is available. Hour by hour WATSUN simulations are used to compate actual and predicted performance.

A statistical summary of all the solar energy systems being monitored has been created and is included in the report.

3.0 Current Status of Monitoring Program

This section summarizes the tasks listed below including explanations and relevant dates:

i) instrument and monitor new sites

ii) continue monitoring and reporting on the remaining sites as well as new sites

iii) prepare an Annual Summary Report for the above sites

3.1 Installation of Instrumentation

The monitoring contractor installed and calibrated instrumentation at three high-level and three low-level monitoring sites.

Table 3-1 lists the sites for which instrumentation was required and the date on which installation was completed.

3.2 Installation of High-Level Monitoring Instrumentation

Five sites have been designated as candidates for high-level monitoring. These sites are listed in Table 3-1.

The concept of high-level monitoring is discussed in Section 5, where results are presented and measurements are compared with WATSUN simuation data.

Site	Monitoring Equipment Installation Date	Comments
Albion Community Centre	January 1985	
Cavalier Beverages		Equipment installed by system contractor
London Hospital Linen Services	April 1985	
Niagara Powermatic		System will not be monitored
Ottawa Hospital Linen Services	April 1985	
St. Elizabeth Home Society	July 1985	
Trent Timber	May 1985	

Table 3-1
New Sites

3.3 Instrumentation Repair/Recalibration

The reduction in the number of sites being monitored brought about an obvious reduction in instrumentation repairs. However, there were occasional problems with flowmeters and temperature sensors as listed below:

1. Failure of driving mechanism on mechanically driven pulseheads.
2. Corrosion failures in iron flowmeters and systems where water is exceptionally corrosive.
3. Failure of temperature sensing elements.

Specific descriptions of the various failures can be found in the individual monthly reports.

3.4 Status of Monitoring Systems

During the three year life of the monitoring program, one hundred and twelve solar energy sites have been instrumented, monitored and reported upon. Monitoring results for these sites have been presented in the Annual Summary Reports for 1983 and 1984.

Forty-five solar energy systems were monitored by the monitoring contractor during the twelve months between November 1984 and October 1985. During that period monitoring was discontinued for an additional forty-two sites. In most cases adequate information had been obtained to satisfy the requirements of the monitoring program. These sites are listed in Table 3-2.

Monitoring will be discontinued at the end of October 1985 at forty of the aforementioned forty-five sites. The remaining five sites are equipped with high-level monitoring equipment and are listed in Section 3.2. Ministry of Energy personnel will continue to monitor these sites remotely.

Site	Termination Date
Algonquin Provincial Park Mew Lake	January 1985
All Saints Anglican Church	January 1985
Anchor Concrete Products	January 1985
Angus Laundromat	January 1985
Applewood Public School	January 1985
Aquafarms	January 1985
Barrie Community Centre	January 1985
Barrie YMCA	January 1985
Bronte Creek Provincial Park	
- Concession Building	January 1985
- Women's Change Room	January 1985
- Men's Change Room	January 1985
Carillon Provincial Park	January 1985
Chutes Provincial Park	January 1985
Copperfields Hotel	January 1985
Darlington Provincial Park	January 1985
Hanover Car Wash	January 1985
Huron Steel Products	January 1985
Inglis Carpet Cleaners	January 1985

Table 3-2
Sites for which Monitoring was Terminated

Site	Termination Date
Johnson, W.G., Swimming Pool	January 1985
Kelsey's Roadhouse	January 1985
Kingston Hospital Laundry	January 1985
Maedels Beverages	January 1985
McDonalds Restaurants	
- Hamilton	January 1985
- Napanee	January 1985
- Sault Ste. Marie	January 1985
- Toronto	January 1985
- Windsor	January 1985
Metrus Industrial Park	January 1985
Muskoka Sands Hotel	January 1985
Oakville Trafalgar Memorial Hospital	January 1985
Petawawa Senior Citizens Home	January 1985
Peterborough Fire Hall	January 1985
Peterborough Kinsmen Arena	January 1985
Plant Bath Pool	January 1985
Polysar	January 1985
Rene Brunelle Provincial Park	January 1985
Sarsfield Senior Citizens Home	January 1985

Table 3-2
Sites for which Monitoring was Terminated

Sites	Termination Date
Sheffield Senior Citizens Home	January 1985
Sibbald Point Provincial Park	January 1985
Walkerton Point Provincial Park	January 1985
Windsor Senior Citizens Home	January 1985
York Electroplating	January 1985

Table 3-2
Sites for which Monitoring was Terminated

4.0 General Observations on Solar Heating System's Performance

For the purpose of drawing general conclusions on solar system performance, solar installations have been combined in groups with similar types of loads or configurations. The groups selected are provincial parks, swimming pools and resorts, residential systems, restaurants and hotels, community centres and gymnasia, industrial systems, laundries and car washes, and air systems.

4.1 Provincial Park Systems

During the 1984-85 monitoring year, only two provincial park systems were monitored. Both of these systems are located at a remote entry station at Cache Bay in Quetico Provincial Park. These systems which operate for three months of the year are:

1. Cache Bay DHW, which operated after repairs were made to the collectors. The collectors froze and broke during the winter. This system's performance is hampered by insufficient water pressure as it is a gravity fed system.
2. Cache Bay Photovoltaic which provides power for lighting and communications equipment has operated successfully all summer. Due to the lack of valid data for the DHW system, and the absence of predictions for the P.V. system, no graphical comparison will be made for these systems.

4.2 Swimming Pool and Resort Systems

This group consists of eight systems of which four were operated satisfactorily and provided valid monitoring data during the entire 12 month period covered by this report. The remaining sites are:

1. Albion Community Centre, Lindsay Aquatorium and St. Elizabeth Home Society which were all commissioned and instrumented too late to provide a full 12 months of valid monitoring data for this report.
2. Caswell Resort Hotel, where major modifications have left the system shut down for a large portion of the last year. The system is being modified to provide better winter operation.

The solar collection efficiencies in fully operational systems ranged from 9.4% (Kincardine Community Center) to 30.5% (Cameron Heights High School) for this group of systems.

Figure 4.1 compares actual and predicted specific energy for the four sites with adequate monitoring data.

4.3 Residential Systems

The eleven solar energy systems included in the residential group cover a wide range of applications from correctional centers to apartment buildings to senior citizens residences.

The following solar energy sites will not be included in the discussion of this group.

1. Prince William Apartments had an equipment malfunction which caused the system to be shut down.
2. 225 Morningside Avenue, St. Elizabeth Home Society and York Condominiums all experienced flowmeter failures. As a result these systems did not provide sufficient valid monitoring data.

For the remaining seven systems, the system efficiency ranged from 19.3% (Little's Nursing Home) to 56.7% (Ontario Correctional Institute). The correctional centers provided the highest ratings.

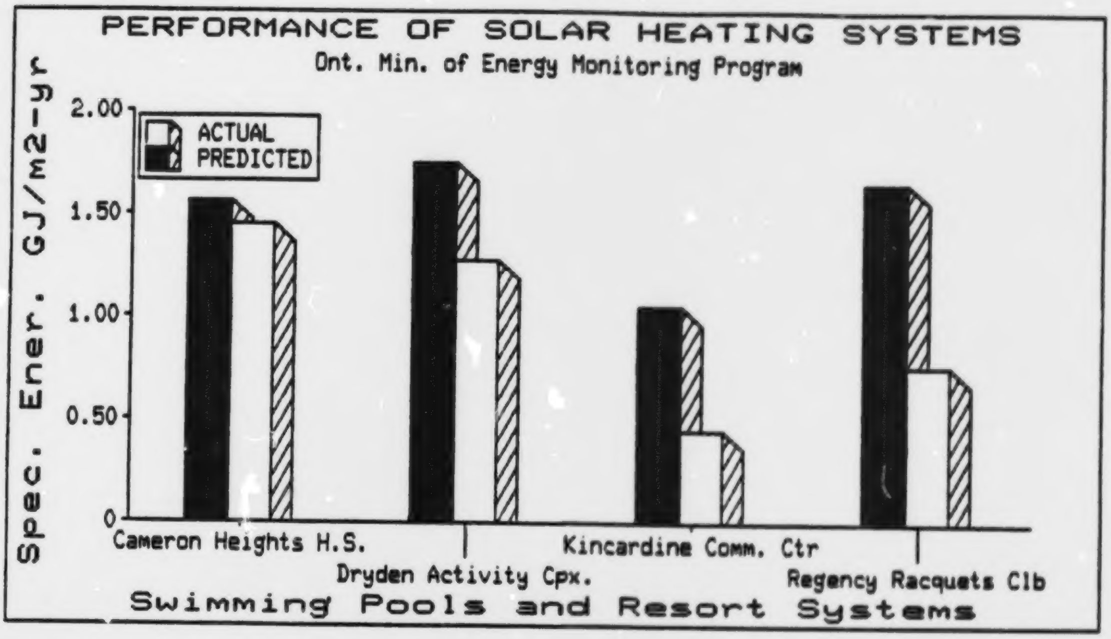

PERFORMANCE OF SOLAR HEATING SYSTEMS
Ont. Min. of Energy Monitoring Program
Spec. Ener. GJ/m2-yr
2.00
1.50
1.00
0.50
0
ACTUAL
PREDICTED
Cameron Heights H.S.
Dryden Activity Cpx.
Kincardine Comm. Ctr
Regency Racquets Clb
Swimming Pools and Resort Systems

Figure 4.1

Specific energy measurements range from 0.93 to 2.72 GJ/m2 - year with 5 sites equalling or exceeding predictions. Figure 4.2 compares actual and predicted specific energy values. The correctional centers exceeded 2 GJ/m2 - year.

In the case of Guelph Correctional Center, the measured solar energy delivered to the load is possibly less than the actual solar delivered. The reason for this discrepancy being that a monitoring temperature sensor failure in November caused the solar energy delivered not to be monitored.

4.4 Restaurants and Hotels

The restaurants and hotels group consists of three systems, two of which were instrumented for the entire twelve month period covered by this report. The remaining site is:

1. Trillium Restaurant which was instrumented in September of 1984. This site was shut down in May, 1985 for reasons listed in the monthly monitoring report.

For the remaining two systems, the system efficiencies were 24.1% (Coral Motel) and 50.0% (Renaissance Motel). The lower efficiency of the Coral Motel system can be attributed to the seasonal nature of this system. The Coral Motel sees a higher load during the summer months.

The specific energies for these systems for the 12 month period were 1.15 GJ/m2-year for the Coral Motel and 2.39 GJ/m2-year for the Renaissance Hotel. Actual and predicted specific energies are compared in Figure 4.3.

4.5 Gymnasia

The gymnasia group consists of two sites of which one has provided sufficient valid monitoring data for this report. The other site is:

1. Carleton University Gymnasium which was instrumented too late to provide sufficient monitoring data for this report. This system is now operating and producing monitoring data.

Queen's University gymnasium had an efficiency of 21.1% and generated a specific energy of 1.01 GJ/m2 - year. This system's under performance can be attributed to a low and sporadic load. Actual and predicted specific energies are compared in Figure 4.4.

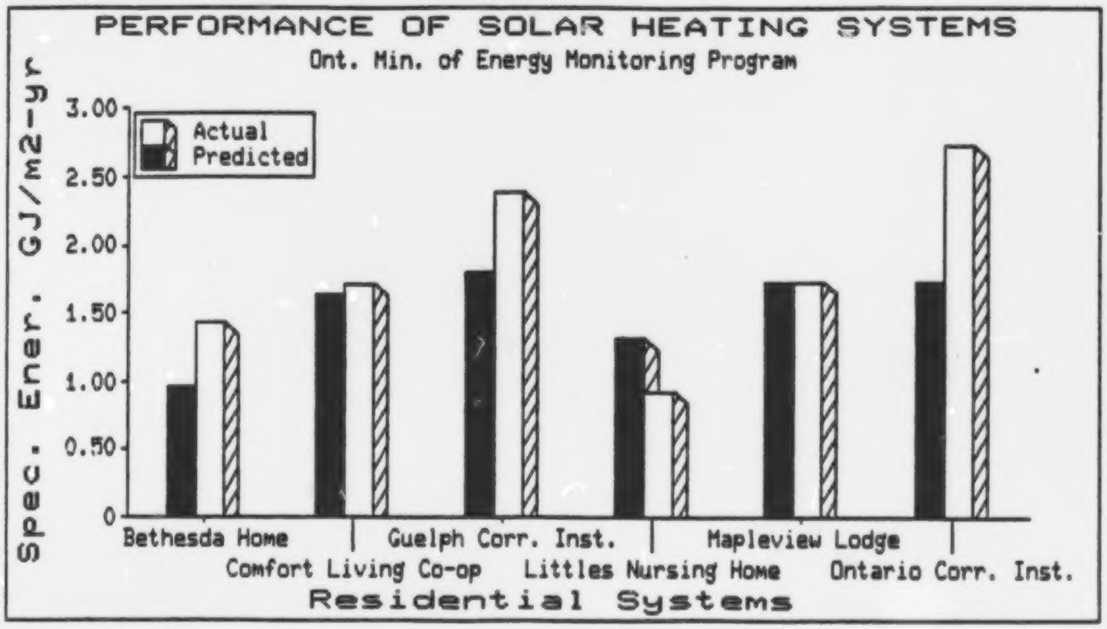


Figure 4.2

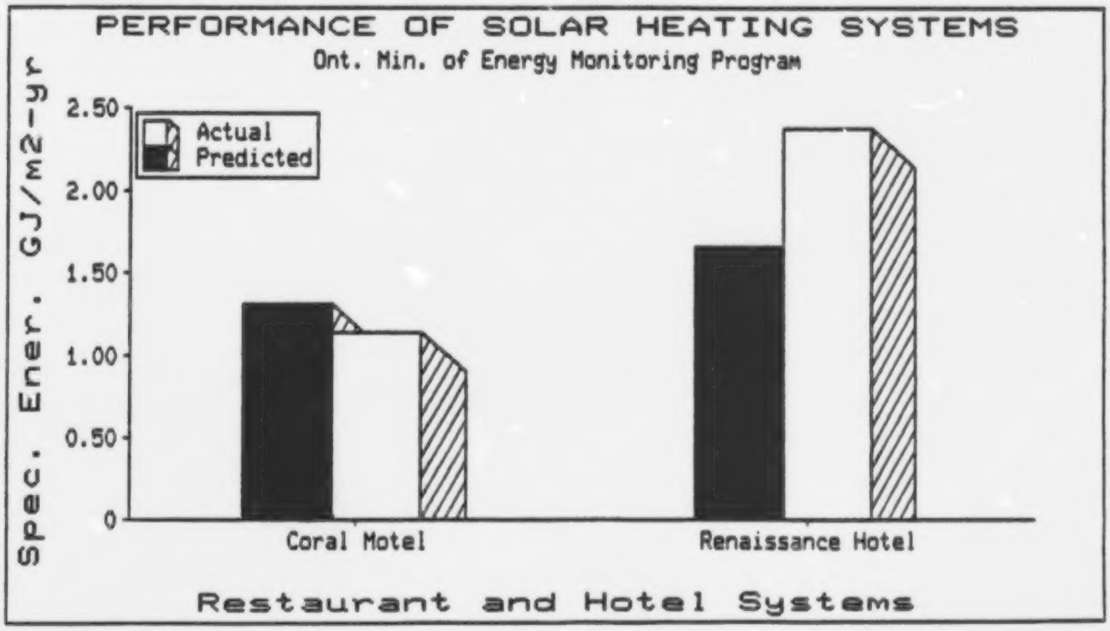


Figure 4.3

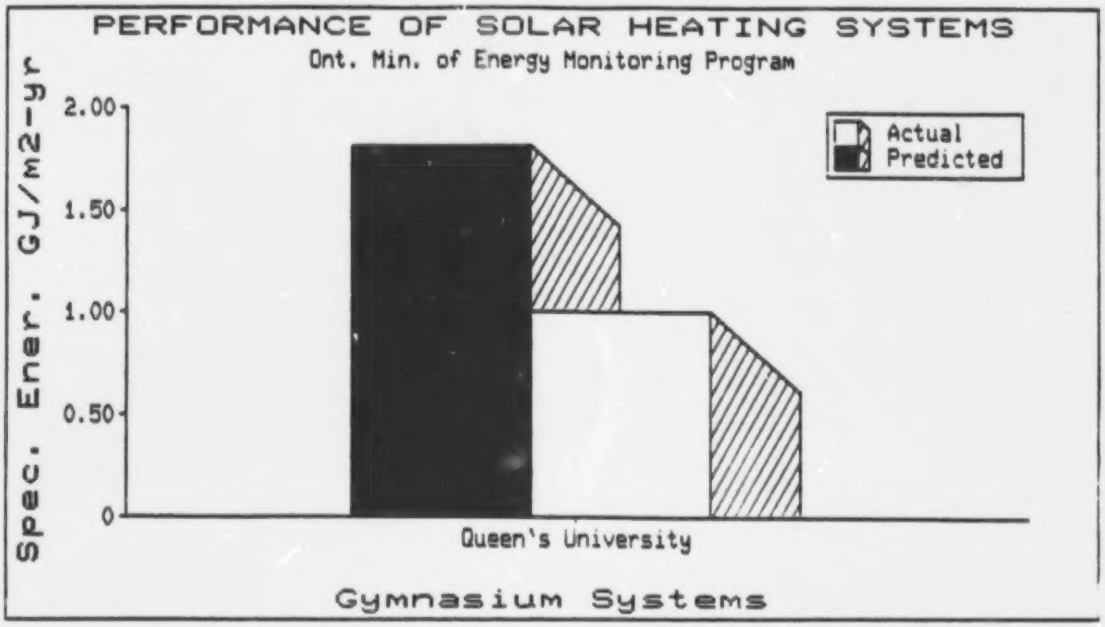

PERFORMANCE OF SOLAR HEATING SYSTEMS
Ont. Min. of Energy Monitoring Program
Spec. Ener. GJ/m2-yr
2.00
1.50
1.00
0.50
0
Actual
Predicted
Queen's University
Gymnasium Systems

Figure 4.4

4.6 Industrial Systems

The industrial systems group consists of 10 sites of which 5 have been instrumented for the twelve month period covered by this report and are operating. The remaining five sites are:

1. Cavalier Beverages Ltd. was instrumented too late to provide sufficient monitoring data. In addition this system was shut down in March 1985 due to system leaks.

2. Christie Brown and Co. has been shut down for the past year.

3. Holiday Juice Co. was shut down for five months due to a control sensor failure.

4. Porritts and Spencer has undergone extensive system modifications.

5. Trent Timber Treating Inc. has produced 3 months of monitoring data and is presently operating. This is an air system which cannot be accurately compared to the liquid systems.

The efficiency ratings of the industrial systems range from 15.4% (Barrymore Carpets) to 39.1% (E.D. Smith & Sons Ltd.). Specific energy ranges from 0.74 GJ/m2 - yr to 1.53 GJ/m2 - yr. Actual and predicted specific energies are compared in Figure 4.5.

One site, Holiday Juice, exceeded the predicted energy. However, this site has not produced enough valid data to be considered in discussion.

4.7 Laundries and Car Washes

The laundries and car washes group consists of eight sites of which five have been instrumented for the entire 12 month period covered by this report. Deluzio Auto Service has produced sufficient data (8 months) to be included in this discussion. The remaining are:

1. London Hospital Services which is operating, instrumented and has produced 2 months of data.

2. Ottawa Hospital Linen Services which is instrumented, however, this site is shut down.

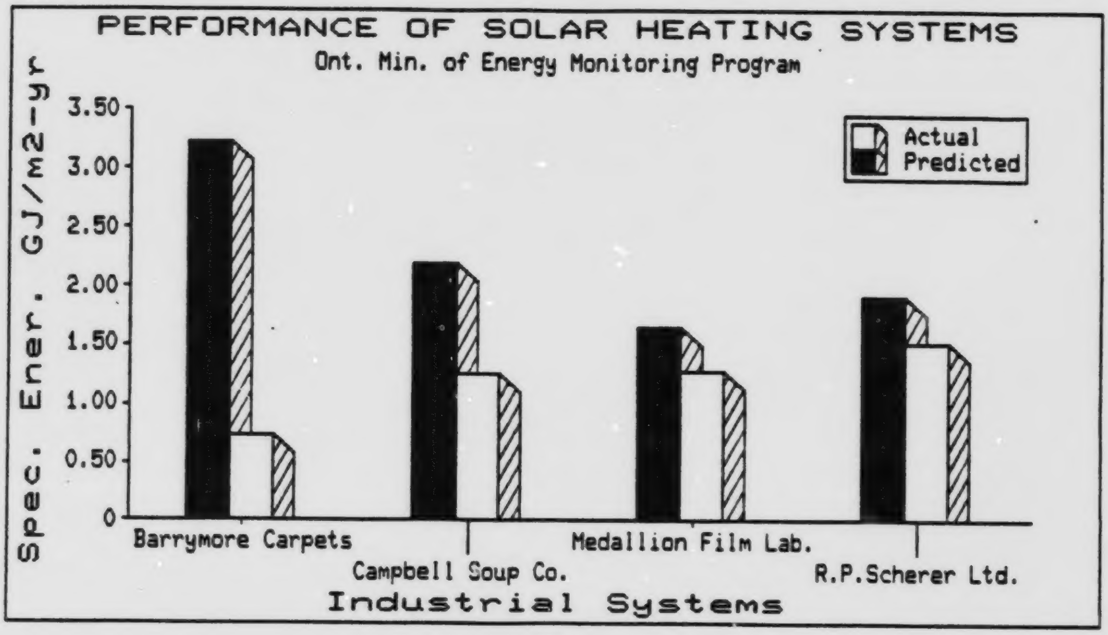

PERFORMANCE OF SOLAR HEATING SYSTEMS
Ont. Min. of Energy Monitoring Program
Spec. Ener. GJ/m2-yr
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0
Actual
Predicted
Barrymore Carpets
Campbell Soup Co.
Medallion Film Lab.
R.P.Scherer Ltd.
Industrial Systems

Figure 4.5

Efficiency for this group ranges from 20.9% (Deluzio Auto Service) to 37.3% (Mohawk Hospital Services). Specific energy ranges from 0.99 GJ/m2 - yr to 1.82 GJ/m2 - yr. Actual and predicted specific energies are compared in Figure 4.6.

4.8 Photovoltaic Systems

This group consists of two systems, one of which was previously discussed in Section 4.1. The other system, Future Pod, Ontario Place, has been instrumented and is operating. This site has provided 7 months of data, during which it has operated at an efficiency of 7.1%.

4.9 Optimally Performing Systems

Figure 4.7a and 4.7b illustrate those sites where actual performance is greater than or equal to 90% of the predicted performance and 12 months of valid monitoring data have been collected.

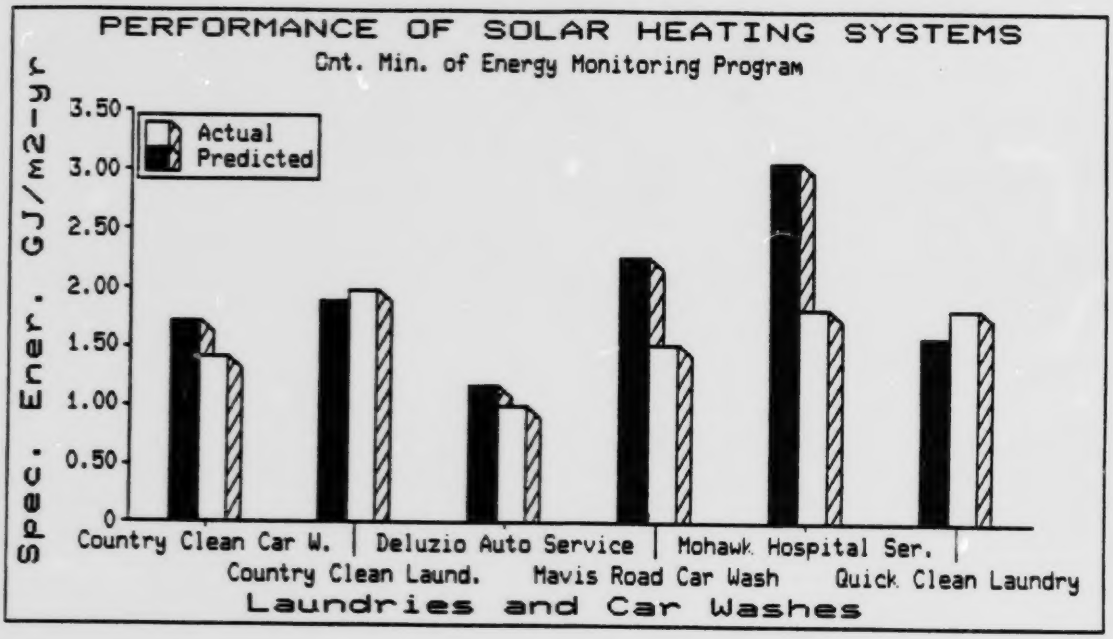

PERFORMANCE OF SOLAR HEATING SYSTEMS
Cnt. Min. of Energy Monitoring Program
Spec. Ener. GJ/m2-yr
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0
Actual
Predicted
Country Clean Car W.
Country Clean Laund.
Deluzio Auto Service
Mavis Road Car Wash
Mohawk Hospital Ser.
Quick Clean Laundry
Laundries and Car Washes

Figure 4.6

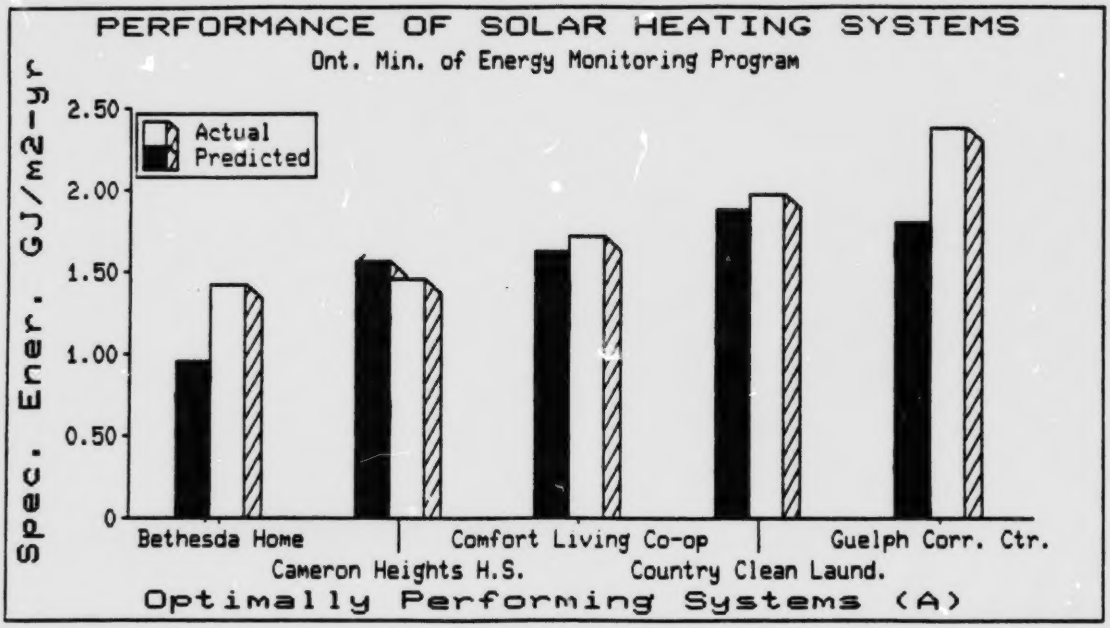


Figure 4.7a

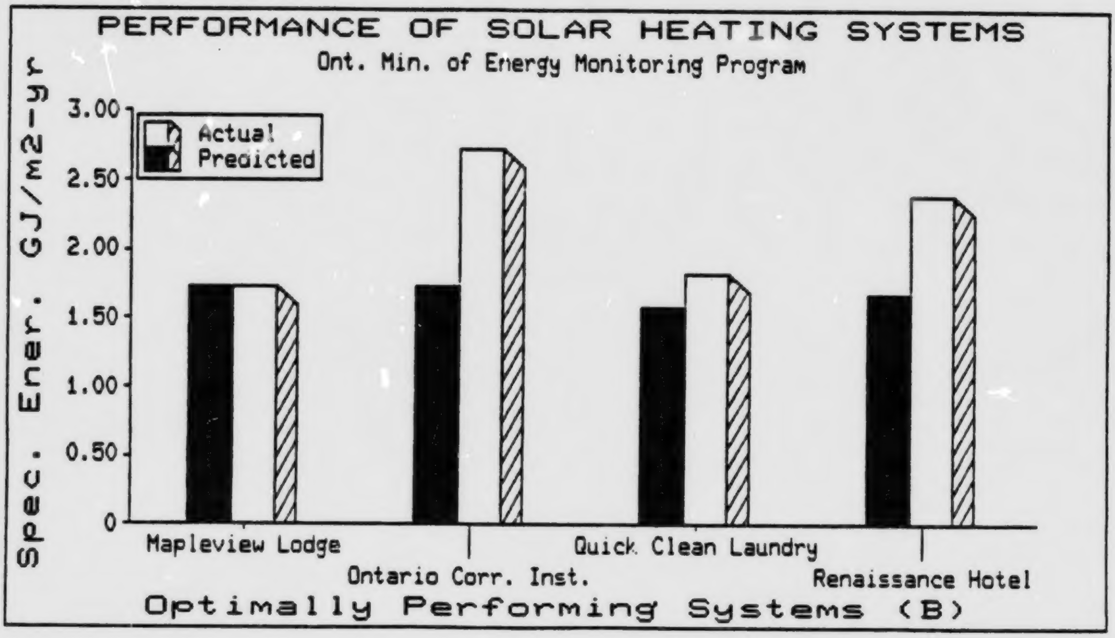


Figure 4.7b

5.0 High-Level Monitoring

During the 1983-84 contract year a decision was made by personnel at the Ministry of Energy to implement a program of high-level monitoring for a limited number of large solar energy collection systems. Tenders were called and several bids were received from vendors. Five systems were ordered in June, 1984 from Admic Controls.

These systems were specified for the following sites:

1. Carleton University Gymnasium
2. London Hospital Linen Services
3. Ottawa Regional Hospital Linen Services
4. E.D. Smith and Sons Ltd.
5. Trent Timber Treating Inc.

It is the purpose of this program to measure and record up to fifteen quantities for each site. In addition, energy measurements are continually calculated and integrated. These energy measurements are also recorded hourly. High-level monitoring will make it possible for the Ministry of Energy and the monitoring contractor to analyze in detail the performance of these five sites by comparing actual performance with simulated performance by the use of software packages such as WATSUN which has been implemented by the monitoring contractor on his computer system.

At the present time, four of the five sites are operating and producing valid data. The other site, Ottawa Hospital Linen Services is shut down.

Carleton University has operated since October of 1984. This site has operated successfully during this time period and has provided valid data since the monitoring equipment was commissioned in May 1985.

London Hospital Linen Services was commissioned in April 1985. The monitoring equipment was commissioned in June 1985. Two months of data have been collected. This system has operated satisfactorily since April 1985.

E.D. Smith and Sons was commissioned in October 1984. The monitoring equipment was also commissioned in October, however, due to monitoring equipment failure in February, only 9 months of data have been collected. This system has demonstrated a reasonable efficiency of 39.1% and a specific energy of 1.38 GJ/m2-year.

Trent Timber Treating Inc. was commissioned in March, 1985 with the monitoring equipment being commissioned in May 1985. A valid amount of data is unavailable at this time as the operation of this system is usually minimal during the summer months. The monitoring equipment at this site is unique in that wet and dry bulb temperatures are measured at the inlet and outlet of the solar heating kiln. This capability enables the relative humidity to be calculated and consequently the amount of moisture removed from the air.

Table 5-1 presents the number and type of each variable measured and calculated at the sites equipped with remote monitoring equipment.

Location	Area (m2)	Type of System	Number of Flow Measurements	Number of Temperature Measurements	Number of Status Measurements	Number of Energies Calculated
Carleton University Gymnasium	375	Liquid	3	10	1	3
London Hospital Linen Services	297	Liquid	1	10	1	1
Ottawa Regional Hospital Linen Services	847	Liquid	2	10	2	3
E.D. Smith & Sons Limited	847	Liquid	2	10	3	2
Trent Timber Treating Inc.	260	Air	1	12	2	2

Table 5-1
Quantities Measured in High-Level Monitoring Systems

A computer simulation using the WATSUN computer program was performed using real load data obtained from the system at E.D. Smith & Sons Ltd. The results of the simulation are compared to actual results in Figures 5.1, 5.2 and 5.3. Figure 5.1 compares the predicted and actual solar storage temperatures for a period of seven days from 85/04/08 to 85/04/14. Figure 5.2 is a comparison of predicted and actual solar storage temperatures for a period of two days from 85/06/04 to 85/06/05. Solar energy delivered to load from 85/06/04 to 85/06/05 is compared in Figure 5.3. These comparisons demonstrate that the WATSUN technique provides an excellent tool for predicting hourly solar energy system operation. Although actual and predicted storage tank temperatures do not track each other exactly, their trends compare very well. In several instances, the predicted values were within 1% of the actual values. The total solar energy delivered to load as predicted for 85/06/04 was within 1% of the actual solar energy delivered to load.

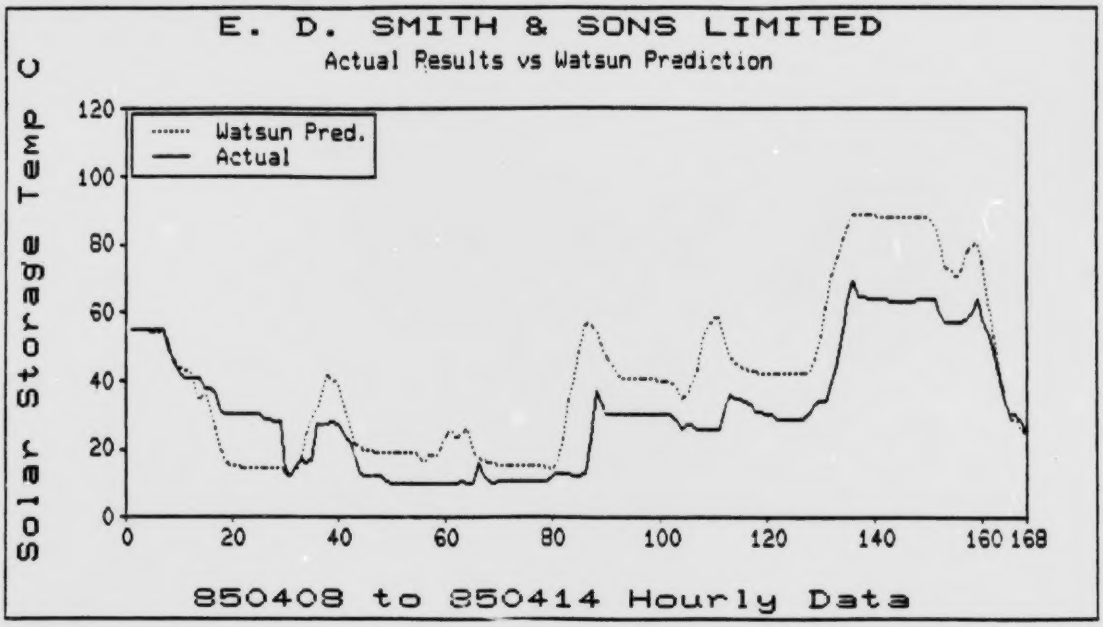


Figure 5.1

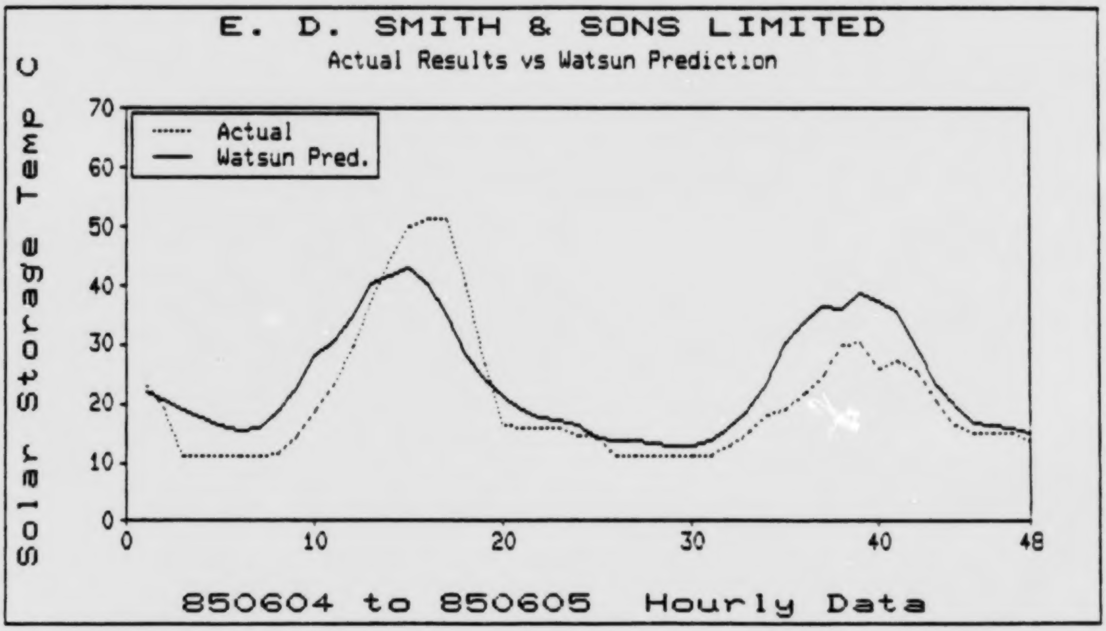


Figure 5.2

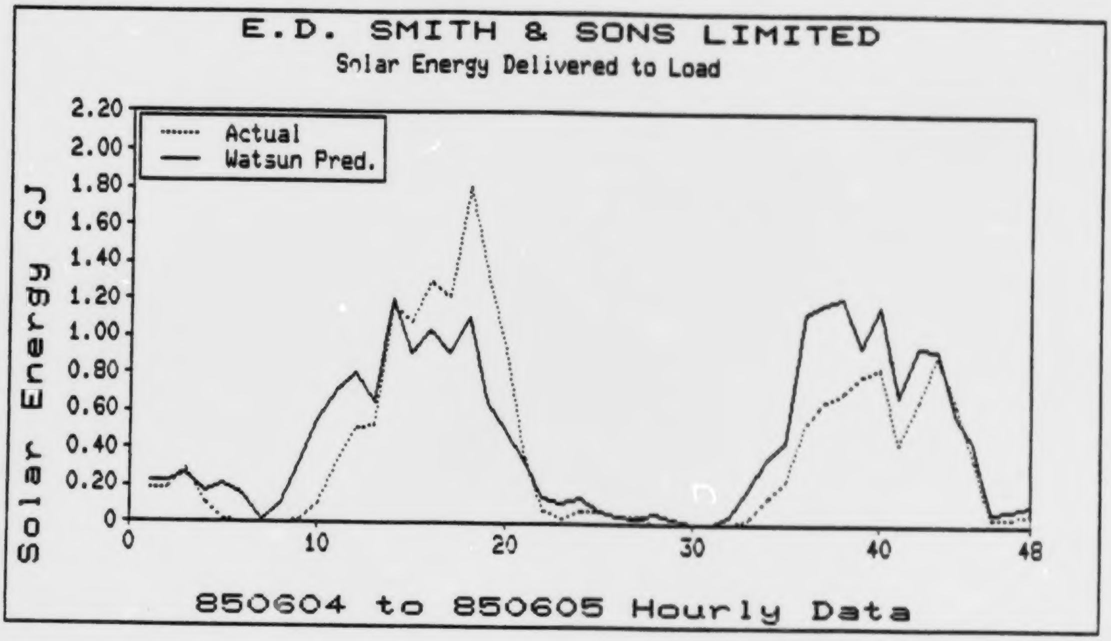

E.D. SMITH & SONS LIMITED
Solar Energy Delivered to Load
Actual
Watsun Pred.
Solar Energy GJ
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0
0
10
20
30
40
48
850604 to 850605 Hourly Data

Figure 5.3

6.0 Solar Energy System Reliability and Performance

This section outlines the overall reliability of the solar energy systems monitored by the monitoring contractor. Numbers of systems in several reliability ranges are listed as well as typical reasons for system failure.

In addition, solar energy system performance is discussed in light of design criteria and load predictions.

6.1 Solar Energy System Reliability

In order to evaluate overall reliability of solar energy systems a study was performed to determine the percentage of the time that each system was operational. For this analysis, forty-five sites were evaluated. The results are shown on the histogram given in Figure 6.1. It should be noted that this evaluation does not consider whether the systems are operating near their design specifications but only whether they are operational.

Four ranges were selected for percentage of operating time:

1. 0 - 25% with 2 sites
2. 26 - 50% with 2 sites
3. 51 - 75% with 5 sites
4. 76 - 100% with 36 sites

Reasons for system downtime include control difficulties, collector coupling leakage, loss of collector vacuum, storage tank leakage, collector and piping freezing, debris in heat exchangers, vandalism, structural damage to collector arrays due to wind loading, glycol degradation and collector damage due to stagnation, circulation pump failures and pump coupling failures.

Individual monthly monitoring reports itemize the reasons for system failures and should be examined for specific problems.

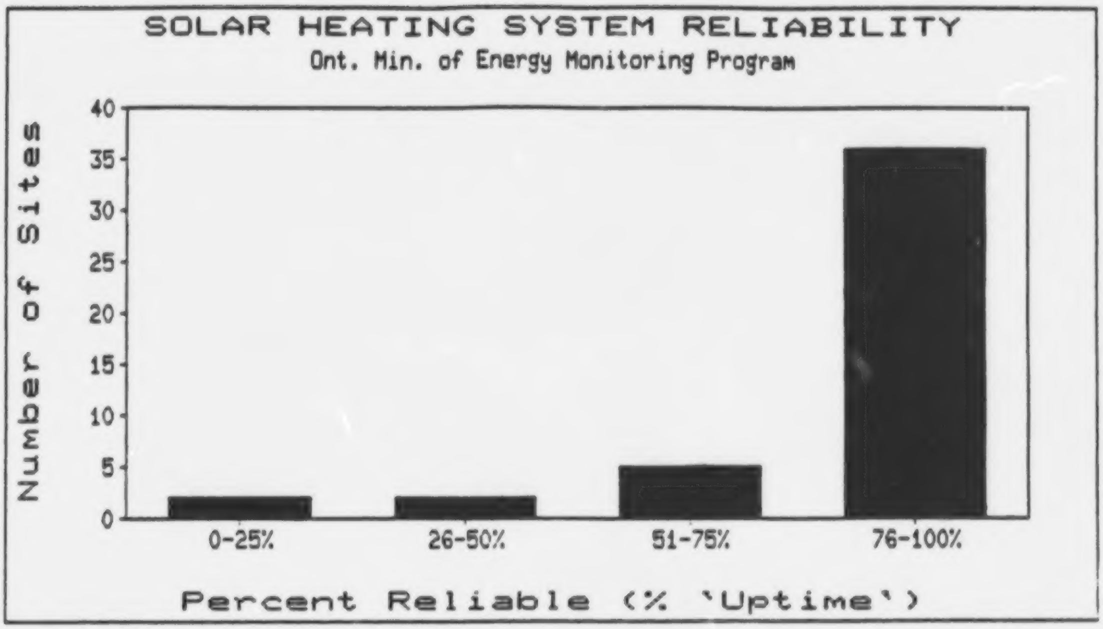

SOLAR HEATING SYSTEM RELIABILITY
Ont. Min. of Energy Monitoring Program
Number of Sites
0
5
10
15
20
25
30
35
40
0-25%
26-50%
51-75%
76-100%
Percent Reliable (% 'Uptime')

Figure 6.1

6.2 Solar Energy System Performance

There are many factors which influence overall system performance such as:

1. appropriate pump capacity
2. relationship between actual and predicted system loads
3. heat exchanger effectiveness
4. proper selection and installation of insulation
5. proper design of control strategies and selection of temperature sensors
6. system maintenance

These factors will be discussed in the following sections.

6.2.1 Effect of Pump Capacity on System Performance

Inadequate pump capacity has degraded performance in several locations with effects ranging from inadequate collector and heat exchanger flow to ineffective use of available storage.

As a matter of interest, pump sizing has probably been the source of most friction between the monitoring contractor and solar system designers. Flow meters are carefully selected to provide no more than 0.5 psi head loss at specified flow. However, it has not infrequently been the contention of system designers that the resistance presented by the flow meter is the cause of inadequate circulation. Since flow meters are always equipped with bypass piping, it is not difficult to determine whether flow meters are impeding flow.

6.2.2 Relationship between Actual and Predicted System Loads

In order that a solar energy collection system performance approach design predictions, it is absolutely essential that realistic loads be determined before starting design. There are many sites being monitored whose actual loads resemble or exceed predicted loads. When these sites possess a well-designed, well-constructed and properly maintained solar energy collection system, they always exhibit superior performance. This may be verified by considering Figures 6-2a, 6-2b and 6-2c which presents a comparison between actual and predicted flow for various sites, and Figures 4-1 to 4-7 which compare actual and predicted solar energy collected.

It is impossible for a site which has been substantially overdesigned due to poor load predictions, poorly designed or poorly constructed to exhibit superior collection properties. Similar comparisons to those suggested above will prove that oversizing results in underperformance.

6.2.3 Heat Exchanger Performance

During the past two years the monitoring contractor has expended substantial effort in the analysis of heat exchanger performance. It is not difficult to understand that low heat exchanger effectiveness can severely degrade solar energy collection.

Low heat exchanger effectiveness can deteriorate performance at even the most meticulously designed sites. The best example of this is Mohawk Hospital Services where careful analysis was evident in all stages of the design. However, debris not properly flushed from the system plugged the heat exchanger so that solar energy collected fell far short of that expected. Measurements performed by the monitoring contractor in December 1983 revealed that heat exchanger effectiveness measured less than 50%. Subsequent investigation, including dismantling the heat exchanger, revealed that the cause was the debris. It should be noted that the plate-type heat exchanger at this site is commonly used and usually gives good performance. System performance improved substantially after the system was flushed.

Immersion type heat exchangers are used at several sites and regularly display inferior performance due to inadequate circulation of the storage water. Although direct effectiveness measurements are difficult to obtain, poor effectiveness is inferred by overall system performance.

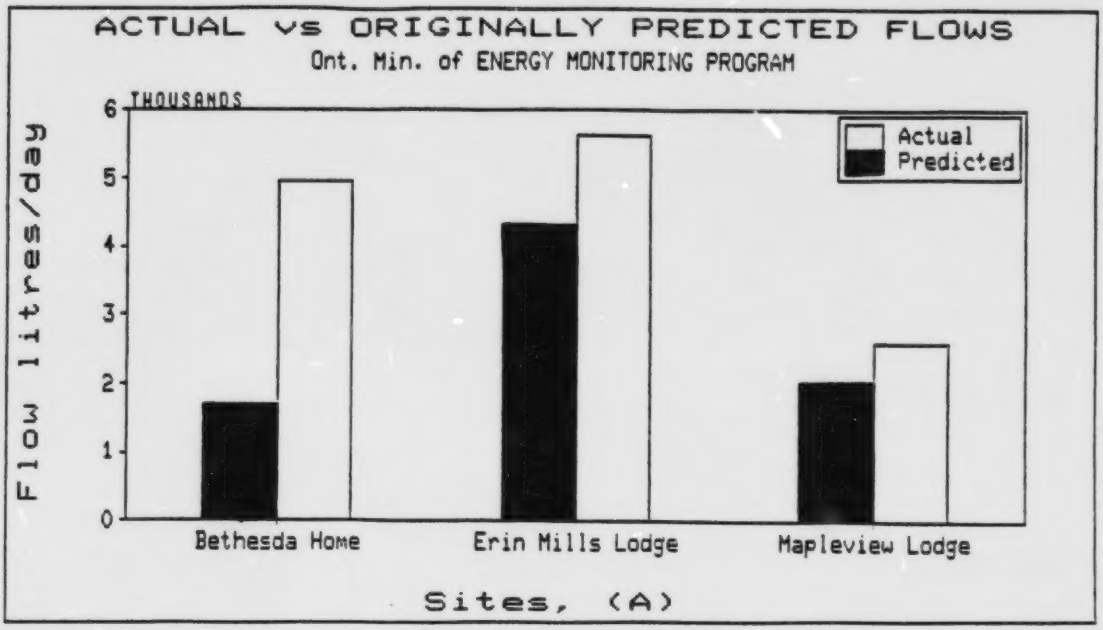


Figure 6-2a

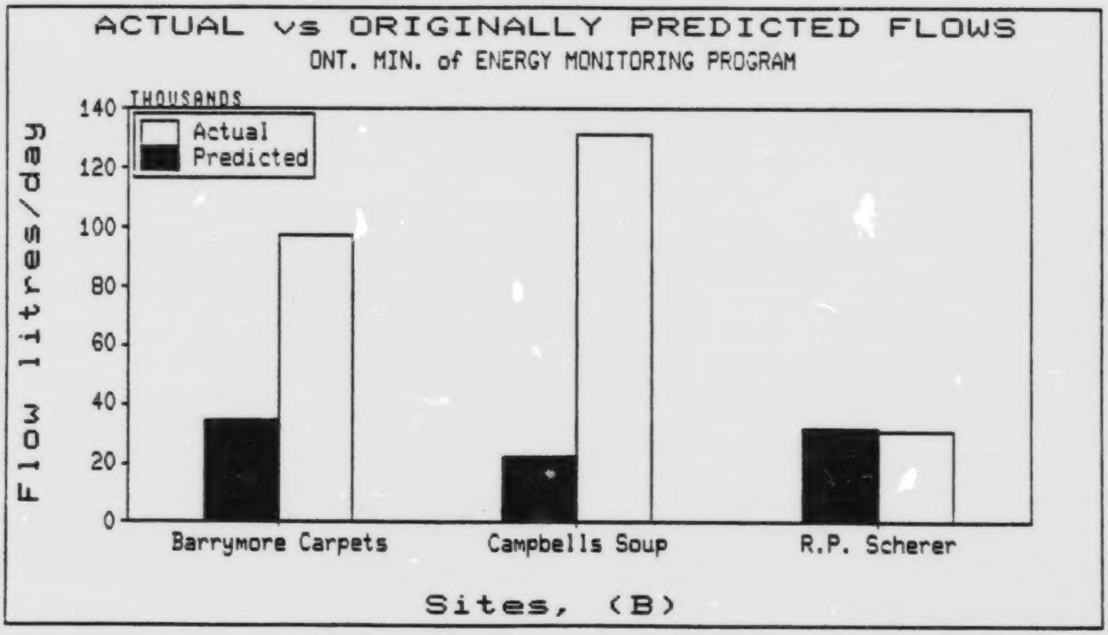


Figure 6-2b

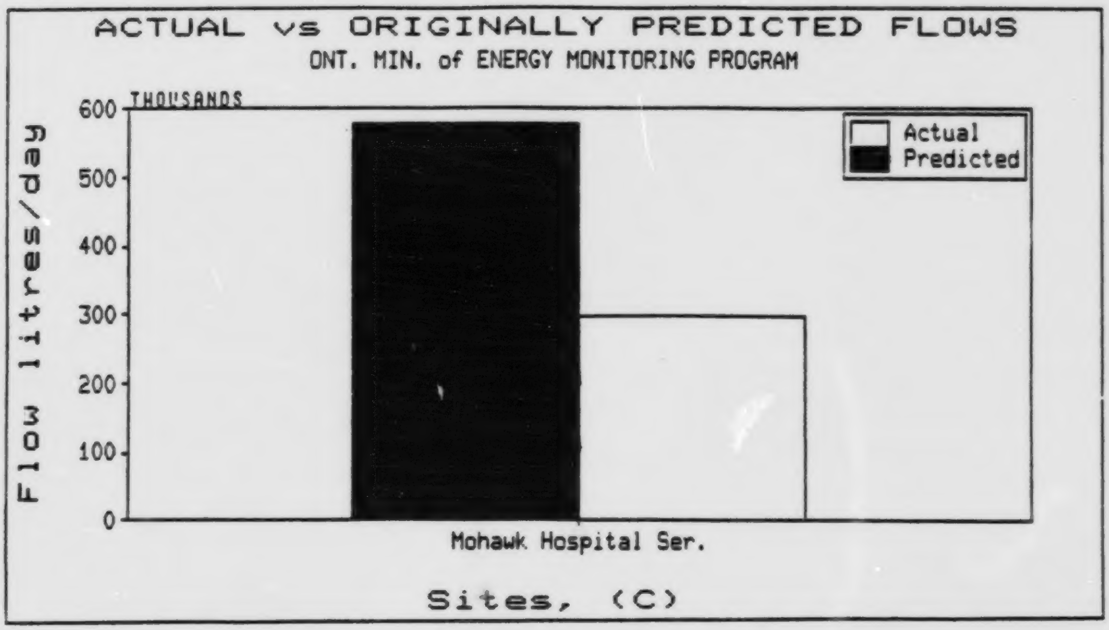

ACTUAL vs ORIGINALLY PREDICTED FLOWS
ONT. MIN. of ENERGY MONITORING PROGRAM
THOUSANDS
600
500
400
300
200
100
0
Flow litres/day
Actual
Predicted
Mohawk Hospital Ser.
Sites, (C)

Figure 6-2c

Other heat exchanger problems include inadequate surface area and poor construction.

Since heat exchanger operation is so crucial, careful analysis is necessary before selection is made. Is recommended that a strainer be installed upstream of the heat exchanger.

6.2.4 Insulation Selection

In most solar energy collection systems, some of the piping is external to a building and thus subject to heat loss during winter conditions. Although heat loss can occur in all seasons, winter conditions give most cause for concern.

In general, piping to solar collectors is insulated but in some cases inappropriate insulation is used which is not impervious to weather and ultra violet degradation. Rapid deterioration occurs resulting in little or no insulation.

This is an area where poor workmanship can be detected very easily since solar collector piping is so visible to an interested observer.

6.2.5 Control Systems

Many problems have been encountered with control systems such as:

1. Defective temperature sensors:

   Proper control is impossible with defective temperature sensors. It is necessary that solar circulation pumps not start until a predefined differential (on-differential) occurs between solar panel and storage tank temperatures. If circulation starts too early, energy will be lost through the collectors. On the other hand, if circulation starts too late, stagnation can occur in solar panels.

   Similarly, solar circulation must cease if an adequate temperature differential (off-differential) is not maintained. If circulation pumps are not turned off energy can be lost through the collectors.

In addition, in below-zero temperature conditions, it is essential that adequate control be effected. In drain-down or drain-back systems, collector and piping freezing can occur while in glycol systems, heat exchanger freezing can result. Proper selection of a freeze stat for drainback and draindown systems is essential.

Proper selection of sensor type is important in high temperature applications. Resistive Temperature Devices should be used in higher temperature areas, such as collector plate sensors. Semiconductor sensors work well at lower temperatures, however at higher temperatures, they tend to fail, which can lead to severe system damage.

2. Incorrect Installation of Temperature Sensors

Temperature sensors must be installed and insulated properly to insure accurate control. The ability of a sensor to sense the correct temperature is dependent on its installation. In all cases it is recommended that the sensors be mounted in a proper thermowell, and that the well extend into the center of the flow. The sensor must be insulated from the ambient to insure accurate temperature measurement.

3. Incorrect temperature set points

Similar problems to those discussed above under "Defective temperature sensors" can result. In addition, if incorrect settings for on-differential, off-differential and time delay exist, then solar energy can be lost and excessive cycling can greatly reduce pump lifetime.

4. Inadequate freeze protection

A substantial portion of the drain back systems monitored by the monitoring contractor have experienced collector and piping freezes due to a variety of causes. These causes include, poor control strategy, defective freeze stats, incorrect sloping of collectors and frozen or plugged air valves.

5. Incorrect sequencing of circulation pumps

   This problem can result in energy loss due to incorrect sequencing of circulation through collectors and heat exchangers. In one case, this problem resulted in a circulation pump attempting to force flow through a closed valve.

6. Uninsulated air valves

   Uninsulated air valves have resulted in frozen collectors. This problem occurs due to the freezing of an air valve which will render it inoperative thus creating an air lock which impedes collector draining during freezing conditions.

6.2.6 System Maintenance

Solar energy collection systems performance can be severely degraded if they are not adequately maintained. Problems with poor maintenance include low or damaged glycol, leaking collectors, inoperable air or vacuum valves, damaged pump couplings, plugged heat exchangers or collector arrays and ineffective control strategy due to damaged controllers or temperature sensors.

7.0 Photovoltaic Systems

The monitoring program currently includes two Photovoltaic systems. The first site to be discussed is located at a remote wilderness park entry station on Cache Bay in Quetico Provincial Park in Northwestern Ontario. The system consists of 24 modules with a peak output of 960 Watts, which is utilized to provide 12 VDC power for interior lighting and communications equipment and 120 VAC power for an absorption cycle refrigerator via an inverter. The system uses 15 deep cycle batteries for storage which are capable of carrying the various loads for approximately three days.

The monitoring instruments were installed in July of 83 and were reconfigured in July 84 to account for the installation of additional loads. The instruments consist of an integrating pyranometer measuring insolation on the same plane as the modules and two Watt-hour meters measuring electrical energy delivered from the photovoltaic array and to the loads. The photovoltaic system has been trouble free since commissioning and the park personnel are particularly satisfied with the performance to date. During the winter months the entry station is shut down and the photovoltaic system is run at 1/6 power to keep the storage batteries active. In mid August 1984, the watt-hour meter measuring electrical energy delivered by the photovoltaic array failed. The site was visited in August 1985 and the Watt-hour meter was removed. It will be returned to the manufacturer for repairs. During the 1985 monitoring period, this system operated trouble free.

The second photovoltaic system in the monitoring program is located at the Future Pod in Ontario Place. This installation consists of 75 modules with a peak output of 3 kilowatts and is grid connected to the local utility using a DC/AC inverter. Commissioning occurred in August of 1984 and is designed primarily as a demonstration project. Instrumention was performed by a separate contractor using watt-hour meters measuring the D.C. output of the array and the A.C. input to the grid. The system has been trouble free since commissioning, and has provided 7 months of valid data from the D.C. Watt-hour meter. The A.C. Watt-hour meter is out of calibration and therefore its readings will not be discussed. This system has provided 2 147.9 KWH of D.C. energy. A prediction using the SUNRAY II computer program indicated 2556 KWH of A.C. energy delivered to the load. It must be noted that before comparing the actual values to the predicted value, a conversion efficiency factor for the inverter must be incorporated.

8.0 Statistical Summary of All Projects

Table 8.1 contains a statistical summary of all projects which have had instrumentation installed. This summary contains site name and location, array area, system type and application, number of months of measured data, number of months of operation, days of operation per week, the theoretical maximum monitoring equipment error, total solar energy to load, total auxiliary energy to load, actual solar fraction, predicted specific energy (GJ/m2 - yr) [F - denotes FCHART prediction using real load data, W - denotes original WATSUN prediction, S - denotes prediction by SUNRAY II simulation program], actual specific energy and repair and maintenance costs.

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	Actual	Repair and Maintenance Costs
Albion Community Centre, Rexdale, 166 m2, Liquid, Swimming Pool Heating	5/12	7		111.68	not measured			0.67	System on Warranty
Barrymore Carpets, Toronto, 332 m2, Liquid, Heating of Industrial Process Water	12/12	5	± 2.0	245.67	not measured		3.22W	0.74	
Bethesda Home, Campden, 59.8 m2, Liquid, Preheat of D.H.W. for Laundry & Residents	12/12	7	± 2.0	85.98	113.79	0.43	0.96F	1.43	$1600.00
Cache Bay. Quetico Provincial Park, 3.2 m2, Liquid, D.H.W. Heating	2/3	7	± 3.0	0.06	1.04	0.05	0.35F	0.02	
Cache Bay, Quetico Provincial Park, 10.92 m2, Photovoltaic, Electrical Power for lighting & communications equipment	2/3	7	± 2.5	0.07	not measured			0.01	
Cameron Heights High School, Kitchener, 250.00 m2, Liquid, Swimming pool heating	12/12	5	± 4.5	365.83	871.05	0.30	1.57F	1.46	$30.00

Table 8-1
Statistical Summary

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	Actual	Repair and Maintenance Costs
Campbell Soup Co., Toronto, 586 m2, Liquid, Preheat of Boiler Make-up water	12/12	7	± 2.0	729.74	not measured		2.20W	1.25	$200.00
Carleton University, Ottawa, 378 m2, Liquid, D.H.W. heating	3/12	7	± 4.0	378.56	not measured			1.00	System on Warranty
Caswell Resort Hotel, Sunridge, 46 m2, Pool heating	1/12	7	± 8.5	8.32	17.01	0.33	0.22F	0.18	$1000.00
Cavalier Beverages Orillia, 432 m2, Liquid, Process Water Heating	2/12	5	± 8.5	11.43	not measured			0.03	System
Christie Brown & Co., Toronto, 360 m2, Liquid, Preheating process water	12/12	7	± 4.5	0.00	11669.37	0.00	2.14F	0.00	
Comfort Living Co-op, Downsview, 214 m2, Liquid, D.H.W. heating	12/12	7	± 4.5	368.30	2966.46	0.11	1.64F	1.72	

Table 8-1
Statistical Summary

Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Previous 12 month period					Repair and Maintenance Costs
				Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr.		
							Pred.	Actual	
Coral Motel, Niagara Falls, 47.8 m2, Liquid, D.H.W. heating	12/12	7	± 4.5	55.09	212.24	0.21	1.32F	1.15	
Country Clean Car Wash, Owen Sound, 45 m2, Liquid, Car Wash	12/12	7	± 4.5	63.27	53.66	0.54	1.72F	1.41	
Country Clean Laundry, Owen Sound, 83 m2, Liquid, Hot water for 45 washing machines	12/12	7	± 4.5	164.01	406.98	0.29	1.89F	1.98	
Deluzio Auto Service, Windsor, 118.9 m2, Liquid, Car Wash	8/12	7	± 4.5	82.75	91.40	0.48	1.16F	0.99	
Dryden Activity Complex, Dyrden, 200 m2, Liquid, Swimming Pool and DHW Heating	12/12	7	± 4.5	255.40	965.09	0.21	1.76F	1.28	$60.00
Erin Mills Lodge, Mississauga, 150 m2, Liquid, D.H.W. heating	12/12	7	± 2.0	203.69	not measured			1.36	System on Maintenance Contract

Table 8-1
Statistical Summary

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	Actual	Repair and Maintenance Costs
Future Pod, Ontario Place, Toronto, 35.6 m2, Photovoltaic Interactive Utility	7/12	7		8.09	not measured		0.40S	0.23	
Guelph Correctional Centre, 238 m2, Liquid, D.H.W. heating	11/12	7	± 2.0	569.47	13741.68	0.04	1.81F	2.39	$325.00
Holiday Juice Company, Windsor, 324 m2, Liquid, Industrial Process Water	7/12	7	± 2.0	374.58	525.39	0.42	0.96F	1.16	$600.00
Kincardine Community Centre, Kincardine, 406 m2, Liquid, Swimming pool heating	12/12	7	± 4.5	183.38	1058.02	0.15	1.05F	0.45	
Lindsay Aquatorium, Lindsay, 119 m2, Liquid, Swimming pool heating	11/12	7	± 4.5	131.89	1088.40	0.11	1.56F	1.11	
Little's Nursing Home, Ridgetown, 135 m2, Liquid, D.H.W. heating	12/12	7	± 8.5	124.89	207.76	0.38	1.32F	0.93	

Table 8-1
Statistical Summary

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	GJ/m2 yr. Actual	Repair and Maintenance Costs
London Hospital Linen Services, London, 297 m2, Liquid, Laundry, Hot Water Preheat	2/12	7	± 4.0	224.57	not measured			0.76	System on Warranty
Mapleview Lodge, Athens, 29.7 m2, Liquid, D.H.W. heating	12/12	7	± 2.0	51.65	124.97	0.29	1.74F	1.74	
Mavis Road Car Wash, Mississauga, 108 m2, Liquid, Car Wash	12/12	7	± 4.5	165.77	597.18	0.22	2.26F	1.53	
Medallion Film Labs, Toronto, 336 m2, Liquid, Heating of process water	12/12	5	± 4.5	432.29	1557.88	0.22	1.66F	1.29	
Mohawk Hospital Services Inc., Hamilton, 2011.9 m2*, Liquid, Hot water for laundry	12/12	7	± 2.0	2819.46	63683.32	0.04	3.08F	1.82	
225 Morningside Ave., Scarborough, 125 m2, Liquid, D.H.W. heating	8/12	7	± 4.5	260.33	611.19	0.23	1.27F	2.08	

* The calculations are based on area of 1547.1 m2 as the Amherst Array was shutdown for 11 months.

Table 8-1
Statistical Summary

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	Actual	Repair and Maintenance Costs
Ontario Correctional Institute, Brampton, 94.89 m2, Liquid, D.H.W. heating	12/12	7	± 4.5	257.86	1536.58	0.14	1.73F	2.72	
Ottawa Hospital Linen Services, Ottawa, 847 m2, Liquid, Dryer Preheat	1/12		± 4.0	110.96	not measured			0.13	
Porritts & Spencer Hamilton, 649 m2, Liquid, Process water heating	8/12	5	± 2.0	122.89	not measured		1.05W	0.19	
Prince William Apts., Belleville, 233 m2, Liquid, D.H.W. heating	10/12	7	± 2.0	44.64	113.59	0.28	0.56F	0.19	
Queen's University, Kingston, 293 m2, Liquid, D.H.W. heating for gymnasium	12/12	7	± 2.0	296.68	727.59	0.29	1.82F	1.01	

Table 8-1
Statistical Summary

Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Previous 12 month period Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	GJ/m2 yr. Actual	Repair and Maintenance Costs
Quick Clean Laundry, Windsor, 47.7 m2, Liquid, D.H.W. heating for washing machines	12/12	7	± 2.0	87.48	1409.98	0.06	1.58F	1.83	$1000.00
Regency Racquets Club, Bramalea, 360 m2, Liquid, D.H.W. & swimming pool heating	12/12	7	± 4.5	278.64	2360.03	0.11	1.66F	0.77	
Renaissance Hotel, Scarborough, 288 m2, Liquid	12/12	7	± 4.5	689.44	4157.59	0.14	1.67F	2.39	
St. Elizabeth Home Society, Hamilton, 65.8 m2, Liquid, DHW heating	8/12	7	± 4.5	78.88	154.78	0.34	1.31F	1.20	
St. Elizabeth Home Society, Hamilton, 315 m2, Liquid, Swimming Pool Heating	0/12	7							
R.P. Scherer Hardcapsule Ltd., Windsor, 495 m2, Liquid, process water heating	12/12	7	± 4.5	757.90	2234.85	0.25	1.91F	1.53	

Table 8-1
Statistical Summary

				Previous 12 month period					
Name of site Location, Area, Type Application	No. of months measured No. of months of operation	Days of Operation per week	Theoretical Maximum Monitoring Equip. Error (%)	Solar Energy to Load (GJ)	Aux. Energy to Load (GJ)	Solar Fraction	GJ/m2 yr. Pred.	Actual	Repair and Maintenance Costs
E.D. Smith & Sons Ltd., Winona, 846 m2, Liquid, Process & Boiler feedwater heating	9/12	7	± 4.0	1168.04	not measured			1.38	
Trent Timber Treating Inc., Peterborough, 222 m2, Air, Preheat of kiln air	3/12	7	± 4.0	15.73	46.53	0.25		0.07	System on Warranty
Trillium Restaurant, Ontario Place, Toronto, 29.78 m2, Liquid, D.H.W. heating	11/12	7	± 2.0	4.03	not measured			0.13	System on Warranty
York Condominium #340, Islington, 310 m2, Liquid, D.H.W. heating	5/12	7	± 2.0	241.00	3688.17	0.07	0.79F	0.81	$1812.00 spent on preven. maint. contract

Table 8-1
Statistical Summary

MONTHLY ACTIVE SOLAR SYSTEMS
MONITORING REPORTS
1985

Prepared for the Ontario Ministry of Energy by
G.K. Fleming and Associates Limited
Thunder Bay, Ontario

NOTE:

Included at the end of this document in Appendix I is a listing of the measured weather data for 1984 obtained from Environment Canada. The site numbers for which the data are applicable are also included. Comparisons can be made between this data and the historic data listed on the last page of the monthly reports.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER #305

REPORT DATE: 85/09/10 PAGE 1

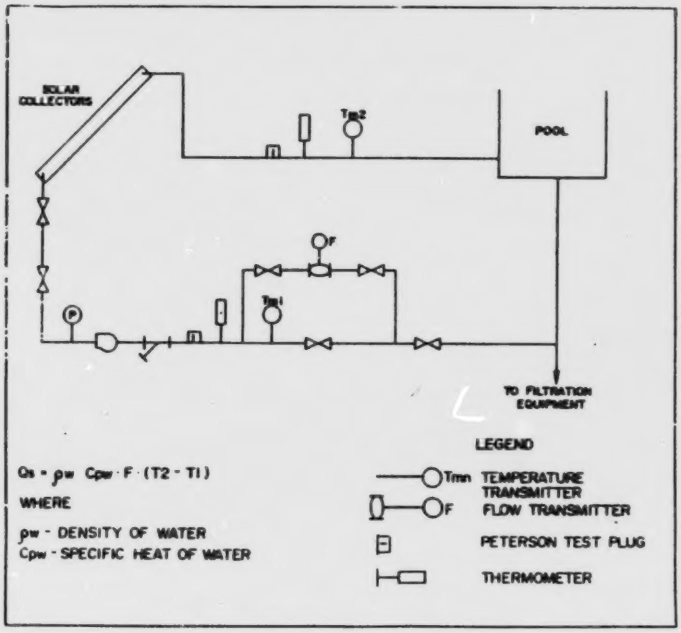
PROJECT NAME: ALBION COMMUNITY CENTRE
Rexdale, Ontario

CONTACT: Richard Lembke
TELEPHONE: (416) 742-3454

A Canada/Ontario Energy
Demonstraton Project

SERVICE: Pool Heating
OPERATING TEMPERATURES: 27 Degrees C Inlet: 29 Degrees C Demand
COMMISSIONING DATE: 85/03/01 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
Tm2
POOL
F
Tm1
P
TO FILTRATION EQUIPMENT
LEGEND
Qs = ρw Cpw · F · (T2 − T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
Tmn TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: WATERSHED
Collector Fluid - Water
Number of Collectors - 56 Area - 166 m^2
SOLAR STORAGE: Swimming Pool
AUXILIARY HEATERS: Gas-fired boiler
HEAT EXCHANGERS:
MONITORING INSTRUMENTS: Ontario Research Foundation, single channel energy meter, KENT TM200-2" flow meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 305
Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Albion Community Center
Location: Rexdale, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85			16.37		-
APR-85			12.71		-
MAY-85			26.90		-
JUN-85			29.76		-
JUL-85			25.94		-
Totals			111.68		

Units: Gigajoules.

Comments on System Performance:

- The monitoring equipment was installed and commissioned 85/01/11.
- Auxiliary energy is not monitored at this site.
- This is a drain back system, with pool water circulating through the collectors when the solar pump is started.
- Control problems at this site caused the solar circulation pump to lose its prime. As a result the collectors were cold filled after stagnation. The resulting steam explosion melted some PVC pipes. The damage was repaired by the system contractor. The control strategy at this site should be modified to ensure this won't occur again. (June 1985)

Site number: 305

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Albion Community Center
Location: Rexdale, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 203

REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: BARRYMORE CARPETS
Toronto, Ontario

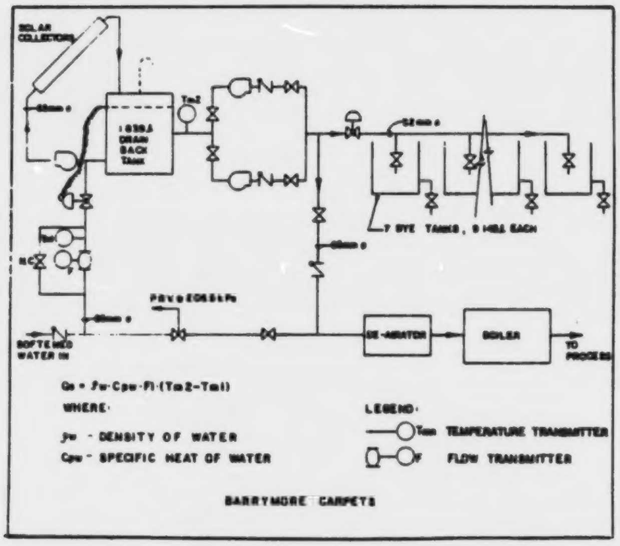
CONTACT: Bob Koep
TELEPHONE: (416)537-1201

A Canada/Ontario Energy
Demonstration Project

SERVICE: Industrial Process
OPERATING TEMPERATURES: 6 Degrees C Inlet; 100 Degrees C Demand

COMMISSIONING DATE: February 2, 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK
Tm2
Tm1
NC
7 DYE TANKS
SOFTENED WATER IN
DE-AERATOR
BOILER
TO PROCESS
Qs = ρw·Cpw·Fl·(Tm2−Tm1)
WHERE:
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND:
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
BARRYMORE CARPETS

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: NORTEC
Collector Fluid - Water
Number of Collectors - 170 Area - 332 square meters
SOLAR STORAGE: 64,000 litres
AUXILIARY HEATERS: Boiler
HEAT EXCHANGERS: None
MONITORING INSTRUMENTS: Kent TM2000, 2.0", Flow meter
Rho sigma RS 805 FP single energy meter
VARIABLES:
Qs - total useful solar heat delivered to the load

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Barrymore Carpets
Location: Toronto

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84			28.63	2499000	Plant shutdown 84/08/01 to 84/08/14.
SEP-84			28.60	3377000	-
OCT-84			26.90	3074000	-
NOV-84			13.12	4052590	-
DEC-84			7.32	2261520	Plant shutdown for holiday break 84/12/20 to 85/01/09.
JAN-85			6.77	3033040	Plant shutdown 85/01/01 to 85/01/09.
FEB-85			3.33	2680550	-
MAR-85			19.94	3038730	-
APR-85			27.54	2632746	-
MAY-85			21.31	2784334	-
JUN-85			42.56	4092148	-
JUL-85			19.65	2019104	Plant shutdown 85/07/18 to 85/08/06.
Totals			245.67	35544762	

Units: Energy = Gigajoules , Water Usage = litres

Comments on System Performance:

- Monitoring equipment commissioned 83/07/27. Auxiliary energy, Q(a) is not measured at this site.
- The load at this site is variable and the system does not operate on weekends. These factors would tend to yield a reduction in efficiency.
- This system does not have any independent freeze protection.
- Poor collector performance due to blockage and/or failure contributes to low system efficiency. Approximately one half of the collectors are not collecting energy.
- A plant shutdown in July and August of 1985 has resulted in reduced system performance for those months.
- Investigation with a strip chart recorder has verified that the load is adequate, however between 33% and 66% of the load occurs outside solar collection periods. Increased solar storage may improve efficiency.
- The system was shutdown for 5 days in March 1985 for inspection and pump repairs.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Barrymore Carpets
Location: Toronto

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.0	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-4.6	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 204

REPORT DATE: 85/09/10

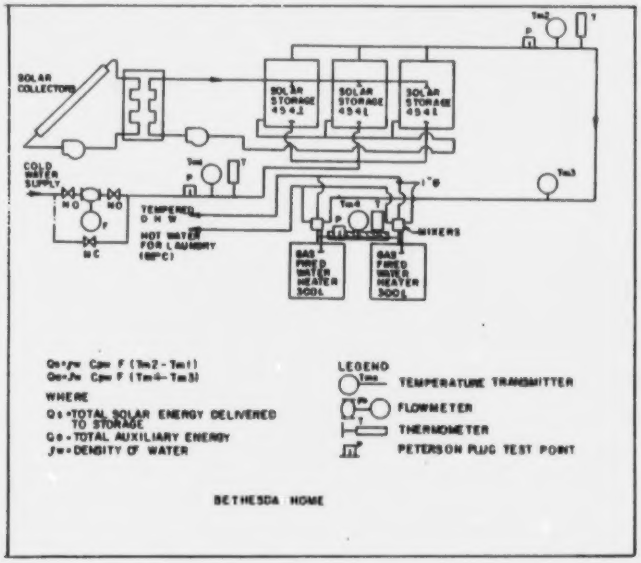
PROJECT NAME: BETHESDA HOME
Vineland, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Chris Lepp
TELEPHONE: (416)562-4184

SERVICE: Preheat for Domestic Hot Water used by laundry and residents
OPERATING TEMPERATURES: 6 degrees C inlet; 75 degrees C demand
COMMISSIONING DATE: Dec 82
REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
SOLAR STORAGE 454 L
SOLAR STORAGE 454 L
SOLAR STORAGE 454 L
Tm2
Tm1
Tm3
Tm4
P
T
F
COLD WATER SUPPLY
NO
NO
NC
TEMPERED D H W
HOT WATER FOR LAUNDRY (82°C)
1"
MIXERS
GAS FIRED WATER HEATER 300L
GAS FIRED WATER HEATER 300L
Qs=ρw Cpw F (Tm2 - Tm1)
Qa=ρw Cpw F (Tm4 - Tm3)
WHERE
Qs=TOTAL SOLAR ENERGY DELIVERED TO STORAGE
Qa=TOTAL AUXILIARY ENERGY
ρw=DENSITY OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOWMETER
THERMOMETER
PETERSON PLUG TEST POINT
BETHESDA HOME

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: ENERSOURCE
Collector Fluid - 50% propylene glycol, 50% water
Number of Collectors - 14 Area - 59.8 square meters
SOLAR STORAGE: 1636.6 litres
AUXILIARY HEATERS: 2 gas fired DHW heaters, 607.5 litres total, (610,000 BTU/hr)
HEAT EXCHANGERS: Noranda HX 886 350 LDDA
MONITORING INSTRUMENTS: Flow meter - Kent 1", C-700
Energy meter - Rho Sigma Dual, (RS815) channel for solar energy delivered; channel for auxiliary energy from DHW heater

VARIABLES:
Qs - total useful solar energy delivered to the load
Qa - total useful auxiliary energy delivered to the same load by the auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Bethesda Home
Location: Vineland,Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			13.08	8.99	-
			(8.83)	(13.24)	
SEP-84			8.45	8.70	-
			(6.60)	(10.55)	
OCT-84			5.61	12.11	-
			(4.98)	(12.74)	
NOV-84			4.22	10.08	-
			(0.50)	(13.80)	
DEC-84			2.54	11.85	-
			(0.00)	(14.39)	
JAN-85			2.92	10.82	-
			(0.88)	(12.86)	
FEB-85			3.06	9.93	-
			(2.74)	(10.25)	
MAR-85			7.28	8.69	-
			(4.63)	(11.34)	
APR-85			8.37	8.30	-
			(5.12)	(11.55)	
MAY-85			10.16	7.06	-
			(6.82)	(10.40)	
JUN-85			9.72	6.34	-
			(7.68)	(8.38)	
JUL-85			10.57	10.92	-
			(8.96)	(12.53)	
Totals			85.98	113.79	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Site contact reports a possible backflow problem. The monitoring contractor will investigate.

- A site visit was made and poor solar performance was attributed to a faulty glycol circulation pump which was replaced in October ,1983 .

- Exceptionaly hard and corrosive local water conditions may be impairing the operation of both pumps and the heat exchanger.

- A consultant has inspected the water at this site and suggests the following to reduce the problems associated with the water;
  - -lower the hot water temperature to 60 deg. C,
  - -soften only the water to be used for hot water,
  - -blend unsoftened water with softened water to achieve a hardness between 60-80 ppm.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Bethesda Home
Location: Vineland,Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		21.0	
SEP-84	420		17.0	
OCT-84	279		10.9	
NOV-84	150		4.7	
DEC-84	130		-1.0	
JAN-85	96		-4.3	
FEB-85	252		-3.7	
MAR-85	403		0.7	
APR-85	510		7.2	
MAY-85	620		13.0	
JUN-85	660		19.0	
JUL-85	682		21.7	

Training and Recent Activity of Site Personnel:

- Doug Walton attended a M. O. E. Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Approximately $1600.00 was spent for repairs which included, repairing leaks, installation of a flow indicator in the glycol loop, moving the pressure relief valve, installation of dielectric unions, coating collector panels with Exolac, and refilling the glycol loop.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 147B

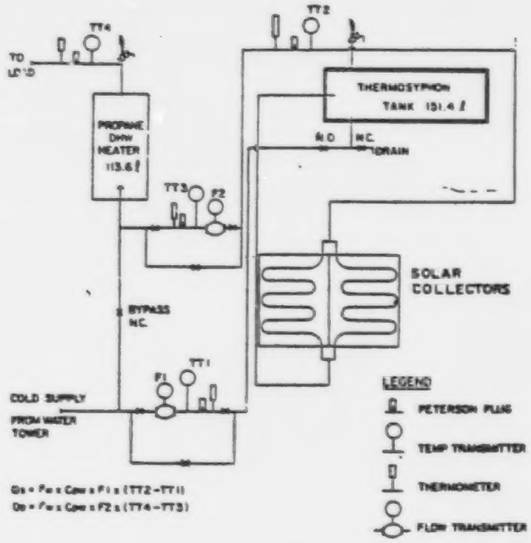
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: CACHE BAY ENTRY STATION
Quetico Provincial Park

CONTACT: Ed Hansson
Janice Matichuk
Peter Puddicombe
TELEPHONE: (807) 597-2737

SERVICE: DHW Thermosiphon (summer only)
OPERATING TEMPERATURES: 2-10 Degrees C Inlet; 50 Degrees C Demand
COMMISSIONING DATE: May 1, 1984 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


TT4
TO LOAD
PROPANE DHW HEATER 113.6 ℓ
TT2
THERMOSYPHON TANK 151.4 ℓ
N.O.
N.C.
DRAIN
TT3
F2
SOLAR COLLECTORS
BYPASS N.C.
F1
TT1
COLD SUPPLY FROM WATER TOWER
LEGEND
PETERSON PLUG
TEMP TRANSMITTER
THERMOMETER
FLOW TRANSMITTER
Qs = ρw x Cpw x F1 x (TT2-TT1)
Qa = ρw x Cpw x F2 x (TT4-TT3)

QUETICO D.H.W SYSTEM

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: Solcan
Collector Fluid - Water
Number of Collectors - 2 Area - 3.2 square meters
SOLAR STORAGE: 151.4 litres
AUXILIARY HEATERS: Propane fired DHW heater, 113.6 litres
HEAT EXCHANGERS: none
MONITORING INSTRUMENTS: 2 - Ista model 2/50 battery powered energy meters

VARIABLES:
- Qs - total useful solar heat delivered to the load
- Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 147B

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cache Bay Entry Station, DHW
Location: Atikokan, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84	1.72		0.06 (0.14)	0.07 (0.00)	-
SEP-84					System shutdown for winter.
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85	0.23		0.00 (0.44)	0.44 (0.00)	Site opened for season 85/06/15.
JUL-85	0.96		0.00 (0.53)	0.53 (0.00)	-
Totals	2.91		0.06	1.04	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- This is a thermosyphon DHW solar heating system. This system is not operated in the winter months.

- The collectors are "shaded" by the Photovoltaic Array until 11:00 a.m. during the summer months.

- A substantial amount of debris was found to have collected in the strainer in the energy meter manifold. This would tend to cause a large pressure drop. Periodic cleaning of this strainer will be necessary.

- The load at this site is low and therefore affects system efficiency.

- Water trapped in the solar collectors froze during the winter causing the pipes to break. The collectors were repaired by Park personnel. As a result the solar heating system did not operate in June 1985.

- The solar heating system suffers from a lack of water pressure. As a result the shower can not be operated unless the system is bypassed. This system would benefit from a higher water tower.

Site number: 147B

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cache Bay Entry Station, DHW
Location: Atikokan, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	496		16.5	
SEP-84	360		11.2	
OCT-84	217		5.5	
NOV-84	120		-3.9	
DEC-84	109		-13.0	
JAN-85	96		-17.7	
FEB-85	252		-14.2	
MAR-85	403		-7.2	
APR-85	510		2.8	
MAY-85	605		9.4	
JUN-85	690		15.3	
JUL-85	651		17.8	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 147A

REPORT DATE: 85/09/10 PAGE 1

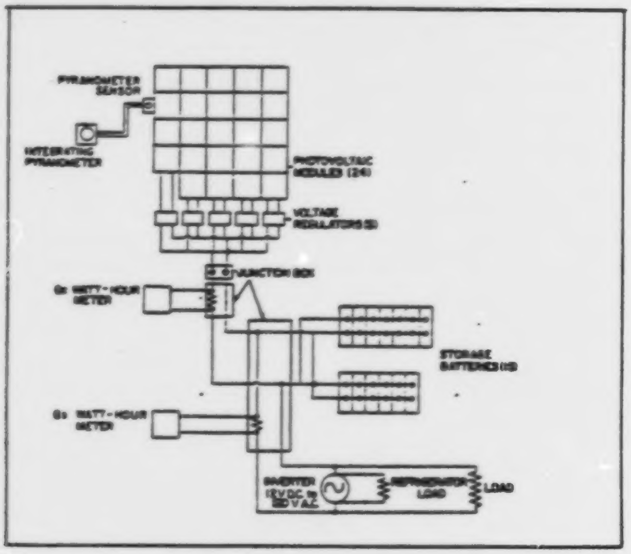
PROJECT NAME: CACHE BAY ENTRY STATION
Quetico Provincial Park

CONTACT: Ed Hansson
Janice Matichuk
Peter Puddicombe
TELEPHONE: (807) 597-2737

SERVICE: Photovoltaic system providing electricity to power lights, communications equipment and a refrigerator (summer only)

COMMISSIONING DATE: May 5, 1984 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


PYRANOMETER SENSOR
INTEGRATING PYRANOMETER
PHOTOVOLTAIC MODULES (24)
VOLTAGE REGULATORS (5)
JUNCTION BOX
WATT-HOUR METER
STORAGE BATTERIES (15)
WATT-HOUR METER
INVERTER 12VDC to 120VAC
REFRIGERATOR LOAD
LOAD

SYSTEM DESCRIPTION:

SOLAR MODULES: Manufacturer: Solarex SX 120, 960 Watts Total
Collector Fluid - None
Number of Modules - 24 Area - 10.92 square meters
SOLAR STORAGE: 15 Delco 12 Volt deep cycle batteries, 1575 Amp-hours total.
AUXILIARY ENERGY SOURCE: 2 KW Onan gasoline powered generator set

MONITORING INSTRUMENTS: Energy from Array - Natural Power, Inc. Model A40 DC Watt-Hour Meter
Energy to Load - Natural Power, In. Model A40 DC Watt-Hour Meter
Insolation - Natural Power, Inc. Model S62 Integrating Pyranometer with a Licor LI-200SB sensor.

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 147A

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cache Bay, Photovoltaic
Location: Atikokan, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84	1631.32		5.44		
SEP-84					System shutdown for winter.
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85	232.07	-	2.30		System started 85/06/15.
JUL-85	903.52	-	5.24		-
Totals	2766.91		12.94		

Units: Kilowatt-hours

Comments on System Performance:

- This system is operated at 1/6 power during the winter months to keep the batteries active by trickle charging.
- During the period from July30,83 to Sept15,83 the insolation recorded was 7739.6 kWh and the energy consumed was 41.42 kWh.
- A 120VAC Inverter was installed in June to operate a refrigerator , which will significantly increase the load.
- Operating the refrigerator electrically during prolonged cloudy periods can drain the batteries down enough to cause the circuit breaker on the inverter to interrupt power.
- The monitoring equipment has been reconfigured to account for all electrical loads. The energy consumed by the inverter is now being monitored.
- A site visit 85/08/07 revealed that the protective cap for the pyranometer sensor was not removed. As a result the Q(i) readings from 85/06/15 to 85/08/07 will be less than the actual Q(i). During this site visit the Q(c) meter was found to be malfunctioning, it was removed for repairs.

Site number: 147A

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cache Bay, Photovoltaic
Location: Atikokan, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	496		16.5	
SEP-84	360		11.2	
OCT-84	217		5.5	
NOV-84	120		-3.9	
DEC-84	109		-13.0	
JAN-85	96		-17.7	
FEB-85	252		-14.2	
MAR-85	403		-7.2	
APR-85	510		2.8	
MAY-85	605		9.4	
JUN-85	690		15.3	
JUL-85	651		17.8	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 310

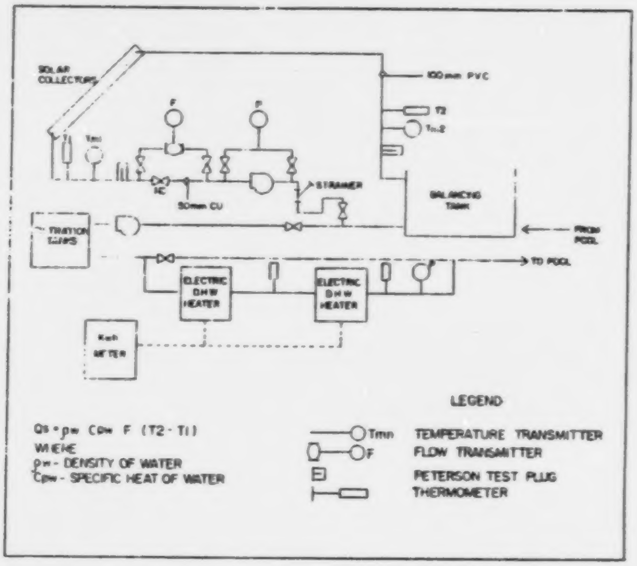
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: CAMERON HEIGHTS HIGH SCHOOL
Kitchener, Ontario

CONTACT: Al Arnold
Mark Schabl
TELEPHONE: (519) 578-8330

A Canada/Ontario Energy
Demonstration Project
SERVICE: Swimming Pool Heating
OPERATING TEMPERATURES: 27 Degrees C Inlet; 29 Degrees C Demand
COMMISSIONING DATE: June 15, 1984 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
100mm PVC
F
F
T2
Tm2
Tm1
T1
NC
50mm CU
STRAINER
BALANCING TANK
FROM POOL
TRATION PUMPS
TO POOL
ELECTRIC DHW HEATER
ELECTRIC DHW HEATER
KWH METER
LEGEND
Qs = ρw Cpw F (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
Tmn TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: Nortec TD 1000
Collector Fluid - Water
Number of Collectors - 84 Area - 250.00 m2
SOLAR STORAGE: Swimming Pool
AUXILIARY HEATERS: 1 - 30 KW, 1 - 60 KW, Electric DHW Heaters
HEAT EXCHANGERS:
MONITORING INSTRUMENTS: Ontario Research Foundation Single Channel Energy Meter, Sangamo KWh, 2" Valmet Hot Water Meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Report Date: JUL/85

Site number: 310

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cameron Heights High School
Location: Kitchener, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			50.60	29.67	-
			(43.02)	(37.25)	
SEP-84			24.20	72.92	-
			(38.65)	(58.47)	
OCT-84			23.90	84.55	-
			(34.16)	(74.29)	
NOV-84			12.83	109.45	-
			(17.12)	(105.16)	
DEC-84			4.59	92.54	-
			(12.34)	(84.79)	
JAN-85			4.71	46.43	-
			(18.05)	(33.09)	
FEB-85			8.50	96.28	-
			(26.93)	(77.85)	
MAR-85			31.70	77.04	-
			(35.78)	(72.96)	
APR-85			38.30	56.52	-
			(34.80)	(60.02)	
MAY-85			54.70	71.71	-
			(42.09)	(84.32)	
JUN-85			53.80	82.18	-
			(44.33)	(91.65)	
JUL-85			58.00	51.76	-
			(45.77)	(63.99)	
Totals			365.83	871.05	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and calibrated July 10, 1984.
- The solar heating system was shutdown for one week in September due to leaks in collector panels and the return line; the leaks have been repaired.
- The auxiliary energy is measured with a Sangamo Kwh meter. In the future elapsed timers will be used to measure auxiliary energy to insure accuracy.
- The solar circulation pump was not producing sufficient head due to a faulty casing. The pump was repaired and is operating properly as of 84/11/08.
- This system was modified in Sept. 1985. Pipes were replaced and a high temperature protection was installed.

Site number: 310

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cameron Heights High School
Location: Kitchener, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Measured	Monthly Mean Ambient Temperature C Historical Mean	Monthly Mean Ambient Temperature C Measured
AUG-84	589		19.7	
SEP-84	420		15.6	
OCT-84	279		9.5	
NOV-84	150		2.9	
DEC-84	130		-3.9	
JAN-85	96		-6.9	
FEB-85	252		-5.8	
MAR-85	403		-1.3	
APR-85	510		6.4	
MAY-85	620		12.6	
JUN-85	660		18.1	
JUL-85	682		20.6	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- A small leak on the supply line to the collectors was repaired at a cost of $30.00.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 205

REPORT DATE: 85/09/10

PAGE 1

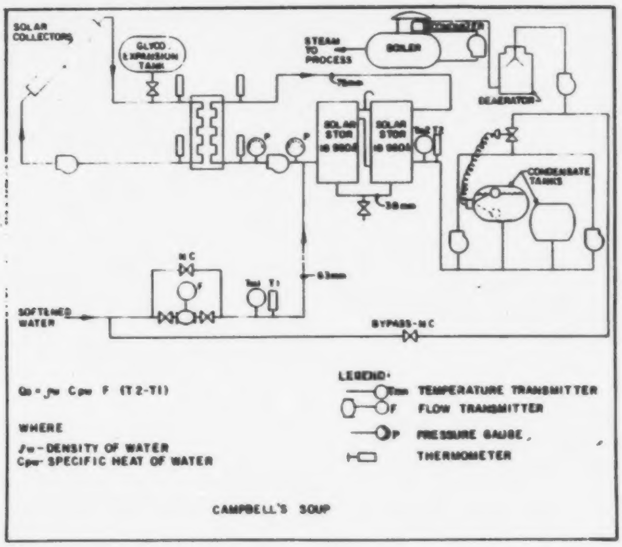
PROJECT NAME: CAMPBELL'S SOUP
Toronto, Ontario

CONTACT: Orlando She
TELEPHONE: (416)251-1131

A Canada/Ontario Energy
Demonstration Project

SERVICE: Boiler make-up pre-heat
OPERATING TEMPERATURES: 8 Degrees C Inlet; 100 Degrees C Demand
COMMISSIONING DATE: January 1, 1982 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
GLYCO. EXPANSION TANK
STEAM TO PROCESS
BOILER
DEAERATOR
75mm
SOLAR STOR
SOLAR STOR
Tm2 T2
P
P
38mm
CONDENSATE TANKS
N C
F
Tm1 T1
63mm
SOFTENED WATER
BYPASS-NC
Qs = ρw Cpw F (T2-T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND:
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
P PRESSURE GAUGE
THERMOMETER
CAMPBELL'S SOUP

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: NORTEC
Collector Fluid - 50% propylene glycol/50% water
Number of Collectors - 262 Area - 586 square meters
SOLAR STORAGE: 27,300 litres
AUXILIARY HEATERS: Steam
HEAT EXCHANGERS: Plate, 24 square meters
MONITORING INSTRUMENTS: 2" Kent TM2000 flow meter
Rho Sigma Rs 805 FP single energy meter
VARIABLES:
Qs - total useful solar heat delivered to the load

Site number: 205
Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Campbell's Soup
Location: Toronto

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84			38.67	2949400	-
SEP-84			30.68	3168700	-
OCT-84			22.73	2811379	-
NOV-84			23.62	5205844	-
DEC-84			13.79	4711670	-
JAN-85			7.43	3233660	-
FEB-85			18.40	5542291	-
MAR-85			43.28	4436090	-
APR-85			55.81	5216210	-
MAY-85			131.29	4318863	-
JUN-85			139.56	4201261	-
JUL-85			97.32	2389922	Plant shutdown 85/06/28 to 85/07/22.
Totals			729.74	48185290	

Units: Energy = Gigajoules , Water Usage = litres

Comments on System Performance:

- The monitoring equipment was commissioned 83/09/07. Q(a) is not measured at this site.
- The make-up water passes through a heat recovery unit on the aftercooler of an air compressor. This preheating will reduce the efficiency of the solar heating system.
- The pipe insulation will be improved.
- During a 3 week plant shutdown, a spare pump was utilized to detour powerhouse make-up water from the solar heating system into the hot water system. This kept the system operating and cool. In addition auxiliary energy was conserved.
- At least 10 collectors have developed working fluid leaks.
- A water circulation pump failure caused shutdowns in August and September which resulted in a reduction in efficiency.
- Approximately 212 litres of glycol were added to the solar heating system in October 1984.
- The plant was shutdown from 85/06/28 to 85/07/22 for annual vacation.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Campbell's Soup
Location: Toronto

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Measured	Monthly Mean Ambient Temperature C Historical Mean	Monthly Mean Ambient Temperature C Measured
AUG-84	589		21.2	
SEP-84	420		17.0	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

- Brian Kerr and Rick Ellis attended a M.O.E. Solar Operator's Seminar on Mar 15,1984 .

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- A time delay relay was installed at an approximate cost of $200.00 .

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 312

REPORT DATE: 85/09/10

PAGE 1

PROJECT NAME: CARLETON UNIVERSITY GYMNASIUM
Ottawa, Ontario

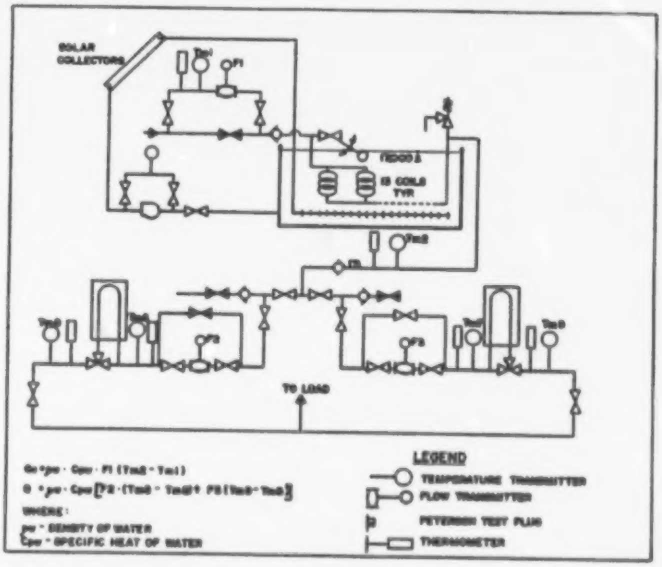
A Canada/Ontario Energy
Demonstration Project

CONTACT: Ben Solomon
Bill Riddel
TELEPHONE: (613) 231-3780

SERVICE: DHW Heating
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand

COMMISSIONING DATE: 84/10/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
Tm1
F1
18 COILS TYP
Tm2
F2
F3
TO LOAD
Qs=pw·Cpw·F1(Tm2-Tm1)
WHERE:
pw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: NORSUN
- Collector Fluid - Water
- Number of Collectors - 126 Area - 378 m2

SOLAR STORAGE: 9000 litres
AUXILIARY HEATERS: Steam Heat Exchanger
HEAT EXCHANGERS: Norsun - emersed coil in tank
MONITORING INSTRUMENTS: Admic Controls Remote Data Acquisition System

VARIABLES:
- Qs - total useful solar heat delivered to the load
- Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Carleton University
Location: Ottawa, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85			106.93	695900	-
JUN-85			98.33	957600	-
JUL-85			173.30	782300	-
Totals			378.56	2435800	

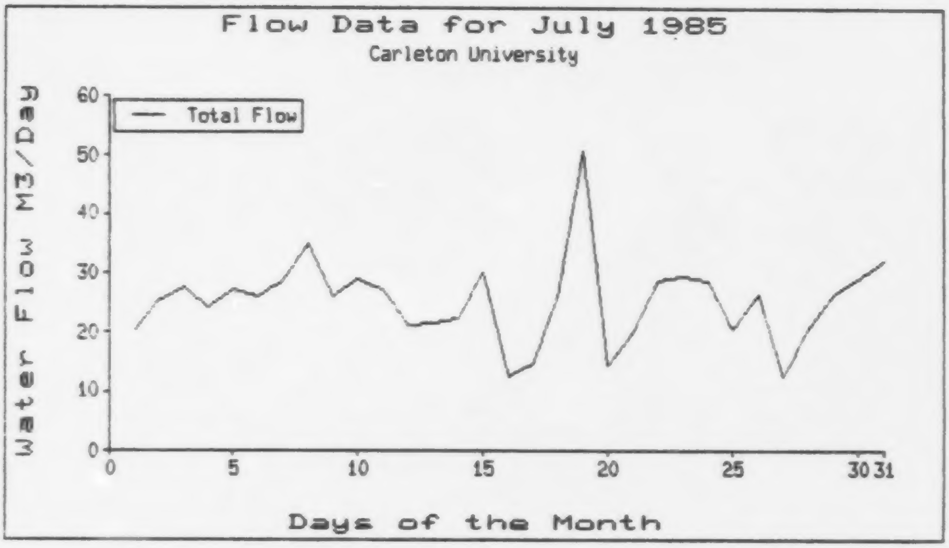
Units: Energy = Gigajoules, Water Usage = Liters

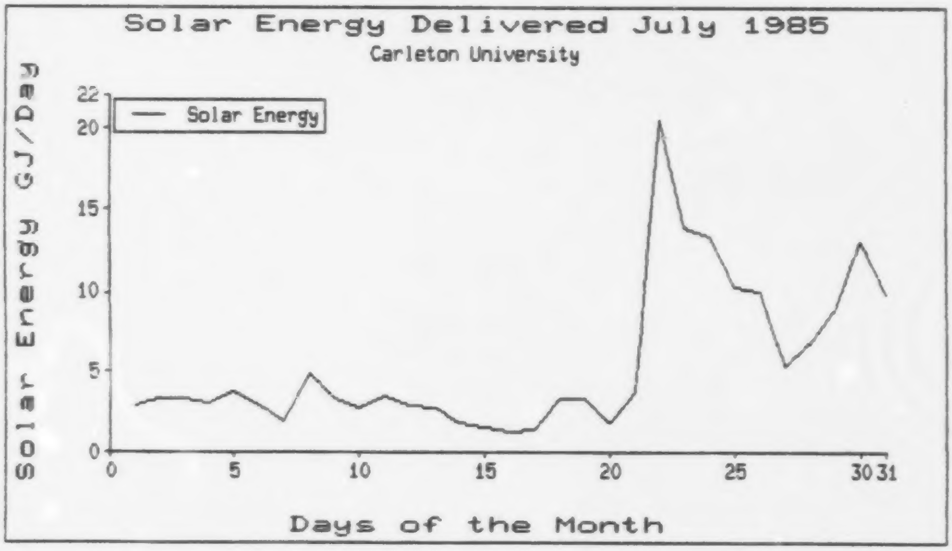
Comments on System Performance:

Site number: 312

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Carleton University
Location: Ottawa, Ontario





ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Carleton University
Location: Ottawa, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		19.4	
SEP-84	420		14.6	
OCT-84	279		8.5	
NOV-84	150		1.6	
DEC-84	130		-7.5	
JAN-85	96		-10.8	
FEB-85	252		-9.5	
MAR-85	403		-2.9	
APR-85	510		5.7	
MAY-85	620		12.8	
JUN-85	660		18.1	
JUL-85	682		20.6	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 206

REPORT DATE: 85/09/10

PROJECT NAME: Caswell Resort Hotel
Sundridge, Ontario

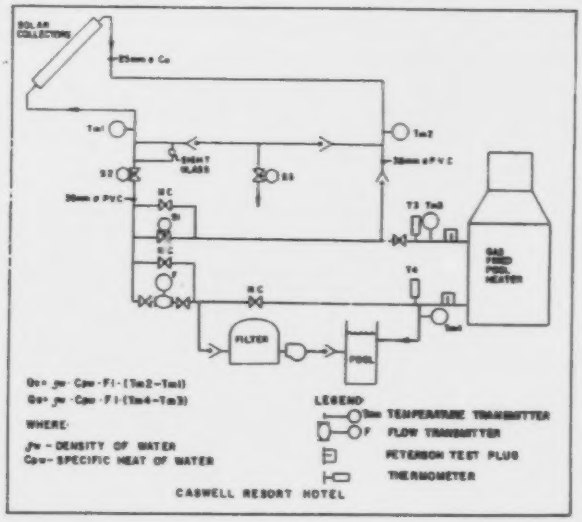
A Canada/Ontario Energy
Demonstration Project

CONTACT: Eric Robinson
TELEPHONE: (705)384-5371

SERVICE: Pool Heating
OPERATING TEMPERATURES: 20 Degrees C Inlet, 28 Degrees C Demand

COMMISSIONING DATE: December, 1982 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
25mm ø Cu
Tm1
Tm2
SIGHT GLASS
S2
S3
30mm ø PVC
30mm ø PVC
NC
NC
NC
T3 Tm3
T4
Tm4
GAS FIRED POOL HEATER
FILTER
POOL
Qs= ρw·Cpw·F1·(Tm2−Tm1)
Qa= ρw·Cpw·F1·(Tm4−Tm3)
WHERE:
ρw − DENSITY OF WATER
Cpw− SPECIFIC HEAT OF WATER
LEGEND
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
CASWELL RESORT HOTEL

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLATHERM
Collector Fluid - Water
Number of Collectors - 15 Area - 46 square meters
SOLAR STORAGE: The pool
AUXILIARY HEATERS: Ray Pak gas fired pool heater, 140,000 BTU/hr.
HEAT EXCHANGERS: None

MONITORING INSTRUMENTS: Flow Meter: 1 1/2" Kent Tm200
Energy Meter: Dual Channel Rho Sigma RS 815-FP
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 206
Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Caswell Resort Hotel
Location: Sundridge

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					System shutdown, awaiting repairs.
SEP-84					System shutdown.
OCT-84					System shutdown.
NOV-84					System shutdown.
DEC-84					System shutdown.
JAN-85					System repaired in JAN.
FEB-85					-
MAR-85					-
APR-85					-
MAY-85			8.32 (10.26)	17.01 (15.07)	Monitoring equipment recommissioned 85/05/09.
JUN-85					System shutdown.
JUL-85					System shutdown.
Totals			8.32	17.01	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Site contact reports some problems with collector coupling leakage which was promptly repaired by the system owner.
- The site contact reports that snow build-up on the collectors has to be swept off frequently.
- Control sensor was damaged by overheating caused by stagnation. Control system may require some examination concerning freeze protection.
- A recent site visit by the monitoring contractor found the controller and solenoids had been tampered with, after corrosion had damaged the stainless steel solenoid valves.
- The solar heating system was repaired by the monitoring contractor in January. The damaged solenoid valves have been replaced and the system was recommissioned.
- The monitoring contractor recommissioned the monitoring equipment 85/05/09.
- The solar heating system has been shutdown to replace the exterior piping. This change will allow the system to be operated in the winter. (June/85)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Caswell Resort Hotel
Location: Sundridge

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.2	
SEP-84	420		13.3	
OCT-84	279		7.4	
NOV-84	150		0.5	
DEC-84	130		-8.5	
JAN-85	96		-12.2	
FEB-85	252		-10.4	
MAR-85	403		-4.1	
APR-85	510		4.2	
MAY-85	620		11.6	
JUN-85	660		16.8	
JUL-85	682		19.4	

Training and Recent Activity of Site Personnel:

- Ben Metcalfe attended a M. O. E. Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Collector coupling repairs cost approximately $100.00 .
- Approximately $1000.00 was spent repairing the solar heating system from August 1984 to May 1985.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER #313

REPORT DATE: 85/09/10 PAGE 1

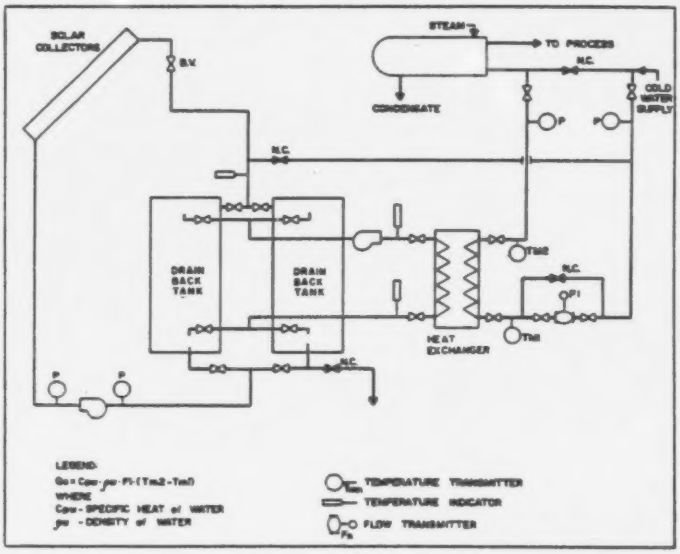
PROJECT NAME: CAVALIER BEVERAGES
Orillia, Ontario

CONTACT: Gary Cameron
TELEPHONE: (705)325-6171

A Canada/Ontario Energy
Demonstration Project

SERVICE: Process Water Preheat
OPERATING TEMPERATURES: 10 Degrees C Inlet; 55 Degrees C Demand
COMMISSIONING DATE: 84/04/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
B.V.
STEAM
TO PROCESS
N.C.
CONDENSATE
COLD WATER SUPPLY
P
P
N.C.
DRAIN BACK TANK
DRAIN BACK TANK
TM2
N.C.
FI
TM1
HEAT EXCHANGER
N.C.
P
P
LEGEND:
Qs = Cpw · ρw · Fl · (Tm2 - Tm1)
WHERE
Cpw - SPECIFIC HEAT of WATER
ρw - DENSITY of WATER
TEMPERATURE TRANSMITTER
TEMPERATURE INDICATOR
FLOW TRANSMITTER
Fl

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN
Collector Fluid - Water
Number of Collectors - 142 Area - 432 m2
SOLAR STORAGE:
AUXILIARY HEATERS: Steam heat
HEAT EXCHANGERS: Alfa Laval P22-VL
MONITORING INSTRUMENTS: Valmet energy meter and valmet flow meter

VARIABLES:
Os - total useful solar heat delivered to the load
Oa - total useful heat delivered to the same load by auxiliary heat source

Site number: 313

Report Date: JUN/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cavalier Beverages Ltd.
Location: Orillia, Ontario

Measured/(Predicted) Performance

Month	O(i)	Q(c)	O(s)	Water Usage	Remarks
JUN-84					-
JUL-84					-
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85			2.10	114800	Energy meter changed 85/02/18.
MAR-85			9.33	511930	-
APR-85					System shutdown.
MAY-85					-
JUN-85					System shutdown.
Totals			11.43	626730	

Units: Energy-Gigajoules, Water Usage-Liters

Comments on System Performance:

- The monitoring equipment was installed by the system contractor. Auxiliary energy is not monitored at this site.
- The energy meter was removed for calibration purposes 85/02/18. It was replaced with another energy meter.
- The solar heating system has not operated since March 1985 due to leaks. The system contractor has been notified, however no action has been taken to date. The system operator has not received operator's manuals as yet.

Site number: 313

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Cavalier Beverages Ltd.
Location: Orillia, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.4	
SEP-84	420		14.2	
OCT-84	279		8.5	
NOV-84	150		1.9	
DEC-84	130		-6.1	
JAN-85	96		-9.7	
FEB-85	252		-9.1	
MAR-85	403		-3.5	
APR-85	510		4.7	
MAY-85	620		11.1	
JUN-85	660		16.5	
JUL-85	682		19.2	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 114

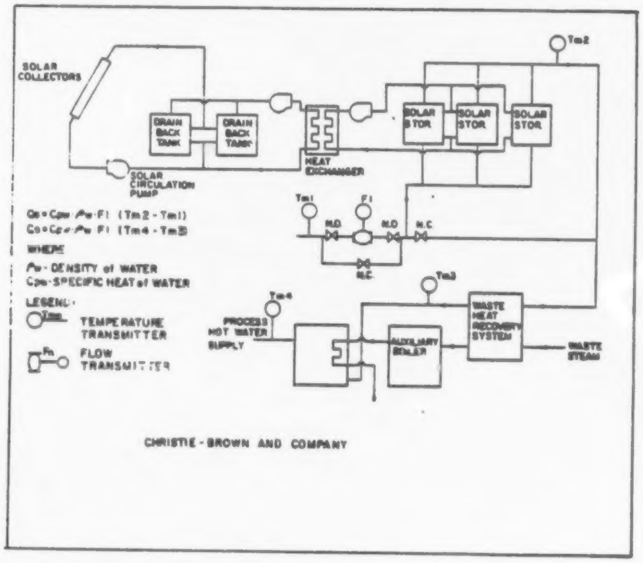
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: CHRISTIE BROWN and COMPANY
Toronto, Ontario

CONTACT: Gord Dawes
TELEPHONE: (416) 252-4411

SERVICE: Preheating Process water
OPERATING TEMPERATURES: 5 degrees C inlet, 50 degrees C demand
COMMISSIONING DATE: October 1982 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy Contact
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK
DRAIN BACK TANK
HEAT EXCHANGER
SOLAR CIRCULATION PUMP
SOLAR STOR
SOLAR STOR
SOLAR STOR
Tm2
Tm1
FI
N.O
N.O
N.C
N.C.
Tm3
Tm4
Qs = Cpw·ρw·FI (Tm2 - Tm1)
Qa = Cpw·ρw FI (Tm4 - Tm3)
WHERE
ρw - DENSITY of WATER
Cpw - SPECIFIC HEAT of WATER
LEGEND:
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
PROCESS HOT WATER SUPPLY
AUXILIARY BOILER
WASTE HEAT RECOVERY SYSTEM
WASTE STEAM
CHRISTIE - BROWN AND COMPANY

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETRO SUN
Collector Fluid - Water (drain back system)
Number of Collectors - 160 in 4 parallel rows Area - 360 square meters
SOLAR STORAGE: 15000 litres
AUXILIARY HEATERS: Gas fired boilers (1230 KW)
HEAT EXCHANGER: Alfa Laval P22VL
MONITORING INSTRUMENTS: Flow meter - 3" Neptune trident
Energy meter - Dual channel ORF energy meter
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Christie Brown and Company
Location: Toronto

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			0.00 (94.33)	561.50 (467.17)	System is shutdown for repairs.
SEP-84			0.00 (79.36)	655.90 (576.54)	System shutdown, repairs underway.
OCT-84			0.00 (66.91)	662.50 (595.59)	-
NOV-84			0.00 (26.47)	715.50 (689.03)	-
DEC-84			0.00 (15.61)	1560.99 (1545.38)	-
JAN-85			0.00 (30.77)	1183.57 (1152.80)	-
FEB-85			0.00 (47.84)	1063.13 (1015.29)	System shutdown.
MAR-85			0.00 (68.42)	1221.76 (1153.34)	-
APR-85			0.00 (69.80)	1041.77 (971.97)	-
MAY-85			0.00 (84.25)	979.65 (895.40)	-
JUN-85			0.00 (90.45)	983.10 (892.65)	-
JUL-85			0.00 (97.76)	1040.00 (942.24)	-
Totals				11669.37	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Defective instrumentation installed by previous monitoring contractor was repaired and recalibrated by present monitoring contractor on April 13,1983. Monitoring data are being collected.
- Monitoring equipment commissioned on June 16,1983
- The solar heating system has been shutdown since January 1984 due to collector leakage problems.
- A possible cause for the leakage problems is damage to the collector couplings caused by "cold filling" the collectors at a time when they were stagnated. In total 48 collectors were damaged.
- The system will be repaired in November 1985.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Christie Brown and Company
Location: Toronto

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

- Byron Penney attended a M.O.E. Solar Operator's Seminar on Mar 15,1984 .
- Byron Penney attended a M. O. E. Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

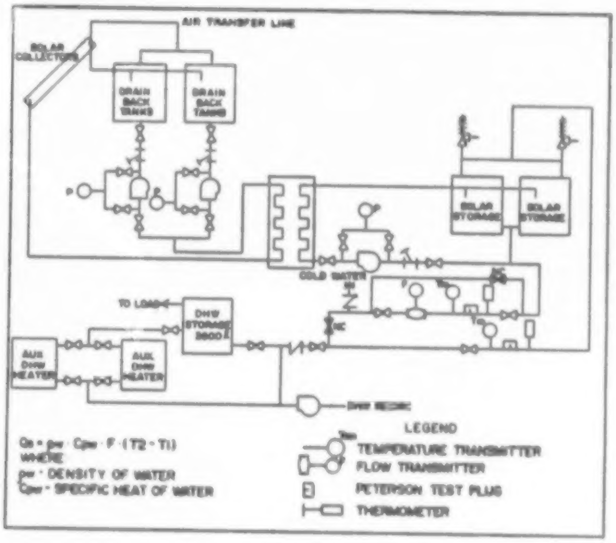
- Site contact reports no expenditures for maintenance or repairs.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 314

REPORT DATE:	85/09/10	PAGE 1	
PROJECT NAME:	COMFORT LIVING CO-OP Downsview, Ontario	CONTACT:	Paul Holliday
		TELEPHONE:	(416)747-1258
	A Canada/Ontario Energy Demonstration Project		

SERVICE: D.H.W. Heating
OPERATING TEMPERATURES: 10 Degrees C Inlet; 57 Degrees C Demand
COMMISSIONING DATE: 84/07/10 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


AIR TRANSFER LINE
SOLAR COLLECTORS
DRAIN BACK TANKS
DRAIN BACK TANKS
SOLAR STORAGE
SOLAR STORAGE
COLD WATER
TO LOADS
DHW STORAGE
AUX DHW HEATER
AUX DHW HEATER
DHW RECIRC
LEGEND
Qs = ρw · Cpw · F · (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUNRAY SR5-48BC-S6
Collector Fluid - Water
Number of Collectors - 80 Area - 214 m2
SOLAR STORAGE: 7250 litres
AUXILIARY HEATERS: 2 gas fired DHW heaters
HEAT EXCHANGER: Shell & Tube
MONITORING INSTRUMENTS: Ontario Research Foundation Single Channel Energy Meter, Valmet 2" Flowmeter, 2 Elapsed Timers
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Comfort Living Co-op
Location: Islington, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84			45.28	172.93	-
			(41.68)	(176.53)	
OCT-84			30.06	195.43	-
			(34.73)	(190.76)	
NOV-84			6.99	296.72	-
			(13.06)	(290.65)	
DEC-84			13.38	358.38	-
			(6.69)	(365.07)	
JAN-85			9.88	361.89	-
			(15.24)	(356.53)	
FEB-85			13.51	327.14	-
			(24.53)	(316.12)	
MAR-85			16.48	364.42	-
			(35.80)	(345.10)	
APR-85			45.34	276.18	-
			(36.65)	(284.87)	
MAY-85			63.15	245.08	-
			(44.69)	(263.54)	
JUN-85			62.68	193.73	-
			(47.44)	(208.97)	
JUL-85			61.55	174.56	-
			(50.53)	(185.58)	
Totals			368.30	2966.46	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 5, 1984.
- A site visit by the monitoring contractor found that the system did not have an independent freeze stat, or a check valve upstream of the system.
- Water that had accumulated in the air transfer line froze, causing the pipe to break. The system owners are waiting for the system installers to repair the pipe.
- Partial repairs were made to this system by the system contractor. Further repairs are required.
- The solar heating system was shutdown for most of February for repairs.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Comfort Living Co-op
Location: Islington, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		19.7	
SEP-84	420		16.0	
OCT-84	279		9.9	
NOV-84	150		4.3	
DEC-84	130		-1.9	
JAN-85	96		-5.0	
FEB-85	252		-4.4	
MAR-85	403		0.1	
APR-85	510		6.3	
MAY-85	620		11.5	
JUN-85	660		17.2	
JUL-85	682		20.1	

Training and Recent Activity of Site Personnel:

- Peter Holiday and Roy McPhee attended a M. O. E. Solar Operator's Seminar Oct. 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 117

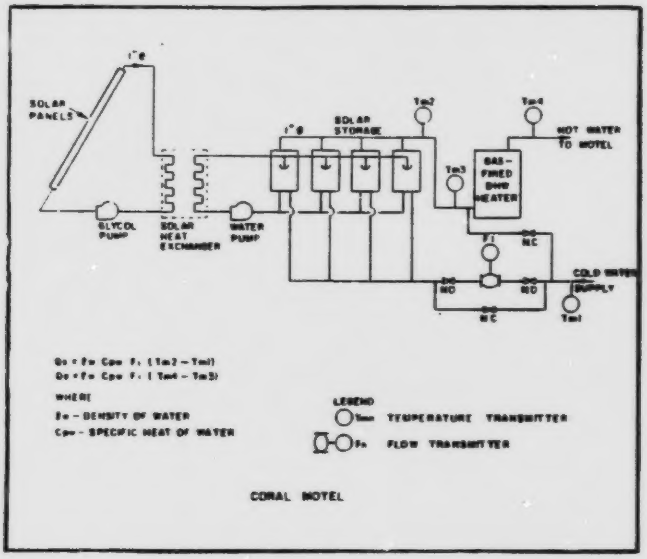
REPORT DATE: 85/09/10

PROJECT NAME: CORAL MOTEL
Lundy's Lane, Niagara Falls, Ont.

CONTACT: J. Orsini
TELEPHONE: (416)354-9922

SERVICE: Domestic hot water.
OPERATING TEMPERATURES: 5 degrees C inlet, 50 degrees C demand
COMMISSIONING DATE: October 1981 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


1" Ø
SOLAR PANELS
GLYCOL PUMP
SOLAR HEAT EXCHANGER
WATER PUMP
1" Ø
SOLAR STORAGE
Tm2
Tm4
HOT WATER TO MOTEL
Tm3
GAS-FIRED DHW HEATER
F1
NC
NO
NO
NC
COLD WATER SUPPLY
Tm1
Qs = ρw Cpw F1 (Tm2 − Tm1)
Qa = ρw Cpw F1 (Tm4 − Tm3)
WHERE
ρw − DENSITY OF WATER
Cpw − SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
CORAL MOTEL

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: ENERSOURCE
Collector Fluid - 60% propylene glycol and water
Number of Collectors - 24 Area - 47.8 square meters
SOLAR STORAGE: 1091 litres
AUXILIARY HEATERS: Gas-fired hot water heater 714 BTU/hr
HEAT EXCHANGER: Manufacturer:Noranda Metalwork HX-886-350-LDO-A
Heat transfer area: 1.5 square meters
MONITORING INSTRUMENTS: Ontario Research Foundation Dual Channel Energy Meter
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 117

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Coral Motel
Location: Niagara Falls, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			7.57	29.59	-
			(8.88)	(28.28)	
SEP-84			5.60	29.79	-
			(6.37)	(29.02)	
OCT-84			3.27	19.94	-
			(4.50)	(18.71)	
NOV-84			1.67	15.23	-
			(1.32)	(15.58)	
DEC-84			0.60	4.07	-
			(0.70)	(3.97)	
JAN-85			0.69	3.19	-
			(1.42)	(2.46)	
FEB-85			1.17	4.68	-
			(2.59)	(3.26)	
MAR-85			3.21	5.33	-
			(4.54)	(4.00)	
APR-85			5.41	8.85	-
			(6.23)	(8.03)	
MAY-85			8.56	22.93	-
			(8.09)	(23.40)	
JUN-85			8.21	32.56	-
			(8.56)	(32.21)	
JUL-85			9.13	36.08	-
			(9.95)	(35.26)	
Totals			55.09	212.24	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Voltage regulator replaced on energy board by monitoring contractor 16 Dec. 1982.
- The load at this site drops dramatically in the winter months.
- This system has no freeze stat, no back flow preventer, and no insulation in mechanical room.
- Data indicates 83% of annual load occurs from April to September (6 months), 85% of annual collected energy is during the same period.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Coral Motel
Location: Niagara Falls, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.4	
SEP-84	420		17.3	
OCT-84	279		11.1	
NOV-84	150		4.6	
DEC-84	130		-1.2	
JAN-85	96		-4.6	
FEB-85	252		-4.0	
MAR-85	403		0.6	
APR-85	510		7.2	
MAY-85	620		13.5	
JUN-85	660		19.3	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Site contact reports that no expenditures were required in the last year for the solar heating system.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 316B

REPORT DATE: 85/09/10 PAGE 1

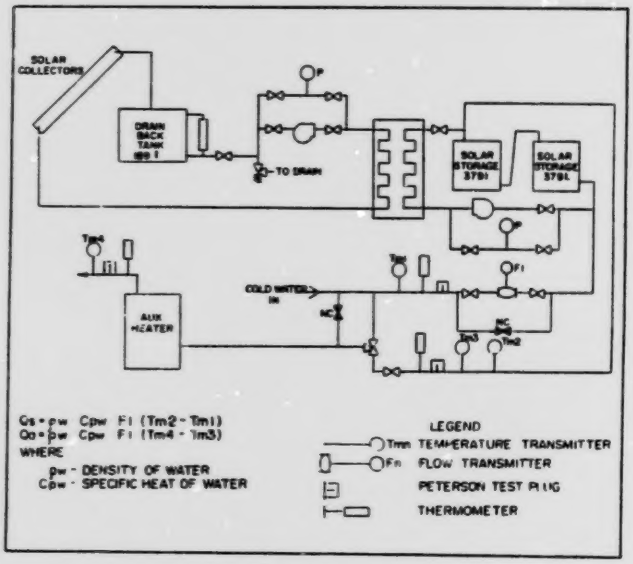
PROJECT NAME: COUNTRY CLEAN CAR WASH
Owen Sound, Ontario

CONTACT: Art Weitendorf
TELEPHONE: (519) 271-1501

A Canada/Ontario Energy
Demonstration Project

SERVICE: Hot water for car wash - 4 bays
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/07/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK 189 l
P
TO DRAIN
SOLAR STORAGE 379l
SOLAR STORAGE 379L
P
Tm4
Tm1
F1
COLD WATER IN
NC
AUX HEATER
NC
Tm3
Tm2
Qs = ρw Cpw F1 (Tm2 - Tm1)
Qa = ρw Cpw F1 (Tm4 - Tm3)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH, S-48
Collector Fluid - Water
Number of Collectors - 15 Area - 45 m2
SOLAR STORAGE: 757 litres
AUXILIARY HEATERS: Rheemglass Model GL85-250 gas fired heater
HEAT EXCHANGERS: Plate type Alfa-Laval P.01M
MONITORING INSTRUMENTS: Ontario Research Foundation Dual Channel Energy Meter, 2" Valmet Flowmeter, Elapsed Timers

VARIABLES:
- Qs - total useful solar heat delivered to the load
- Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Country Clean Car Wash
Location: Owen Sound, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			6.58	1.76	-
			(8.25)	(0.09)	
SEP-84			4.69	1.70	-
			(6.39)	(0.00)	
OCT-84			3.12	1.76	-
			(4.88)	(0.00)	
NOV-84			2.53	7.64	-
			(3.93)	(6.24)	
DEC-84			1.05	9.23	-
			(3.01)	(7.27)	
JAN-85			0.63	7.04	-
			(4.13)	(3.54)	
FEB-85			3.40	9.20	-
			(6.09)	(6.51)	
MAR-85			9.30	7.23	-
			(8.30)	(8.23)	
APR-85			8.38	3.36	-
			(7.63)	(4.11)	
MAY-85			7.76	2.70	-
			(8.36)	(2.10)	
JUN-85			8.26	1.86	-
			(8.63)	(1.49)	
JUL-85			7.57	0.18	-
			(7.75)	(0.00)	
Totals			63.27	53.66	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 25, 1984
- The owner reports that the collectors require repairs as the absorber coating is peeling.
- A vacuum relief valve is causing the circulation pump to become air-locked.
- The owner reports that they have not received operator's manuals as of 85/03/05.
- The owner reports that no action has been taken towards the repair of the collector coatings as of 85/07/02.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Country Clean Car Wash
Location: Owen Sound, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		19.1	
SEP-84	420		15.4	
OCT-84	279		9.9	
NOV-84	150		3.8	
DEC-84	130		-3.0	
JAN-85	96		-6.1	
FEB-85	252		-6.4	
MAR-85	403		-2.0	
APR-85	510		5.2	
MAY-85	620		10.8	
JUN-85	660		16.1	
JUL-85	682		19.4	

Training and Recent Activity of Site Personnel:

- Art Weitendorf attended a M. O. E. Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 316A

REPORT DATE: 85/09/10 PAGE 1

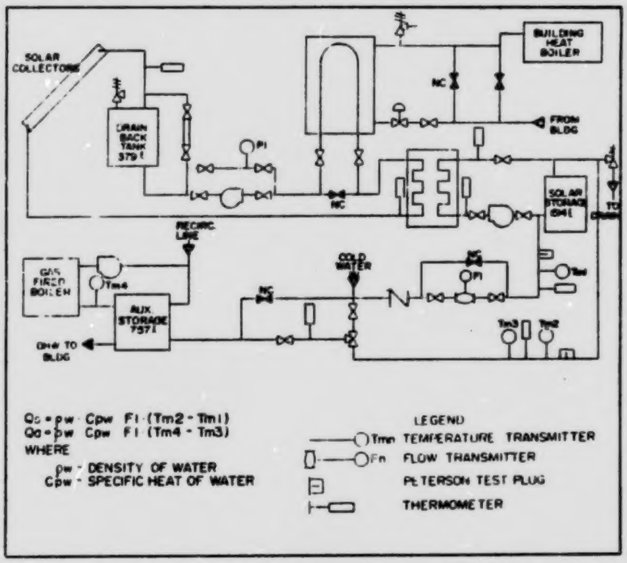
PROJECT NAME: COUNTRY CLEAN LAUNDRY
Owen Sound, Ontario

CONTACT: Art Weitendorf
TELEPHONE: (519) 371-1501

A Canada/Ontario Energy
Demonstration Project

SERVICE: D.H.W. heating for laundry - 45 machines
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/07/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK 379 l
PI
NC
BUILDING HEAT BOILER
FROM BLDG
SOLAR STORAGE 1514 l
TO
RECIRC. LINE
GAS FIRED BOILER
Tm4
AUX. STORAGE 757 l
DHW TO BLDG
COLD WATER
Tm1
Tm3
Tm2
Qs = ρw · Cpw · F1 · (Tm2 - Tm1)
Qa = ρw · Cpw · F1 · (Tm4 - Tm3)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH, S-48
Collector Fluid - Water
Number of Collectors - 28 Area - 83 m2
SOLAR STORAGE: 1514 litres
AUXILIARY HEATERS: Gas fired boiler
HEAT EXCHANGERS: American Standard Tube & Shell 03-072
MONITORING INSTRUMENTS: Ontario Research Foundation Dual Channel Energy Meter
2" Valmet Flowmeter, Elapsed timers
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Country Clean Laundry
Location: Owen Sound, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			19.25	18.07	-
			(18.47)	(18.85)	
SEP-84			13.72	22.38	-
			(15.67)	(20.43)	
OCT-84			9.14	28.17	-
			(13.36)	(23.95)	
NOV-84			5.89	46.36	-
			(5.85)	(46.40)	
DEC-84			2.10	49.92	-
			(3.49)	(48.53)	
JAN-85			0.82	41.06	-
			(6.62)	(35.26)	
FEB-85			5.70	41.50	-
			(10.10)	(37.10)	
MAR-85			19.63	45.99	-
			(14.57)	(51.05)	
APR-85			20.65	36.39	-
			(14.60)	(42.44)	
MAY-85			20.76	29.97	-
			(17.25)	(33.48)	
JUN-85			22.13	26.96	-
			(18.36)	(30.73)	
JUL-85			24.22	20.21	-
			(19.28)	(25.15)	
Totals			164.01	406.98	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 25, 1984.
- The owner reports that the collectors require repairs as the absorber coating is peeling.
- The owner reports that they have not received operator's manuals for this system as of 85/03/05.
- The owner reports that no action has been taken towards the repair of the collector coating as of 85/07/02.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Country Clean Laundry
Location: Owen Sound, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		19.1	
SEP-84	420		15.4	
OCT-84	279		9.9	
NOV-84	150		3.8	
DEC-84	130		-3.0	
JAN-85	96		-6.1	
FEB-85	252		-6.4	
MAR-85	403		-2.0	
APR-85	510		5.2	
MAY-85	620		10.8	
JUN-85	660		16.1	
JUL-85	682		19.4	

Training and Recent Activity of Site Personnel:

- Art Weitendorf attended a M. O. E. Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 320

REPORT DATE: 85/09/10 PAGE 1

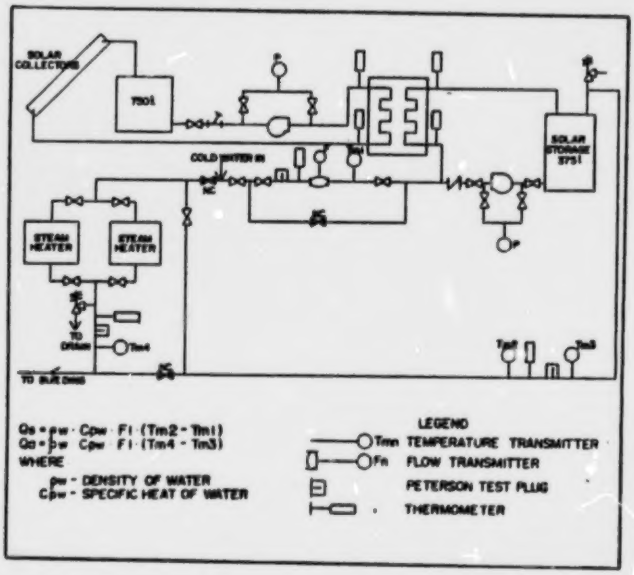
PROJECT NAME: DELUZIO AUTO SERVICE
Windsor, Ontario

CONTACT: Vince Deluzio
Albert Deluzio
TELEPHONE: (519) 254-8422

A Canada/Ontario Energy
Demonstration Project

SERVICE: Car Wash
OPERATING TEMPERATURES: 12 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/07/22 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
750l
SOLAR STORAGE 375l
COLD WATER IN
NC
STEAM HEATER
STEAM HEATER
TO DRAIN
Tm4
Tm2
Tm3
TO BUILDING
Qs = ρw · Cpw · F1 · (Tm2 - Tm1)
Qa = ρw · Cpw · F1 · (Tm4 - Tm3)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUNRAY SR5-48
Collector Fluid - Water
Number of Collectors - 40 Area - 118.9 m2
SOLAR STORAGE: 750 litres
AUXILIARY HEATERS: Steam Heaters
HEAT EXCHANGERS: 1 NIXON V13SST
MONITORING INSTRUMENTS: Ontario Research Foundation dual channel energy meter, 2" Valmet Flowmeter

VARIABLES:
- Qs - total useful solar heat delivered to the load
- Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Deluzio Auto Service
Location: Windsor, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					No data available as system is not operating.
OCT-84					System is not operating.
NOV-84					-
DEC-84			1.03	6.04	System started operating 84/12/12.
			(4.84)	(2.23)	
JAN-85			1.25	10.28	-
			(6.58)	(4.95)	
FEB-85			7.42	32.82	-
			(11.39)	(28.85)	
MAR-85			11.86	32.70	-
			(16.35)	(28.21)	
APR-85			10.30	8.59	-
			(12.98)	(5.91)	
MAY-85			10.10	0.10	-
			(9.73)	(0.47)	
JUN-85			18.20	0.38	-
			(16.05)	(2.53)	
JUL-85			22.59	0.49	-
			(18.83)	(4.25)	
Totals			82.75	91.40	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Monitoring equipment installed and commissioned July 27, 1984.
- The control sensor and high temperature cut-out on the storage tank are incorrectly located.
- The drain back time for this system is greater than 8 minutes which could result in freezing of the fluid in the pipes.
- A check valve has been added at this site to prevent backflow.
- The insulation on the storage tank is inadequate and poorly installed. The control wiring is poorly installed.
- The collector slope is 70 degrees from horizontal to improve performance in the winter months.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Deluzio Auto Service
Location: Windsor, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.3	
SEP-84	420		17.4	
OCT-84	279		11.1	
NOV-84	150		4.4	
DEC-84	130		-1.9	
JAN-85	96		-4.9	
FEB-85	252		-3.8	
MAR-85	403		1.2	
APR-85	510		8.1	
MAY-85	620		14.2	
JUN-85	660		19.7	
JUL-85	682		22.2	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY MONITORING REPORT
SITE NUMBER 122

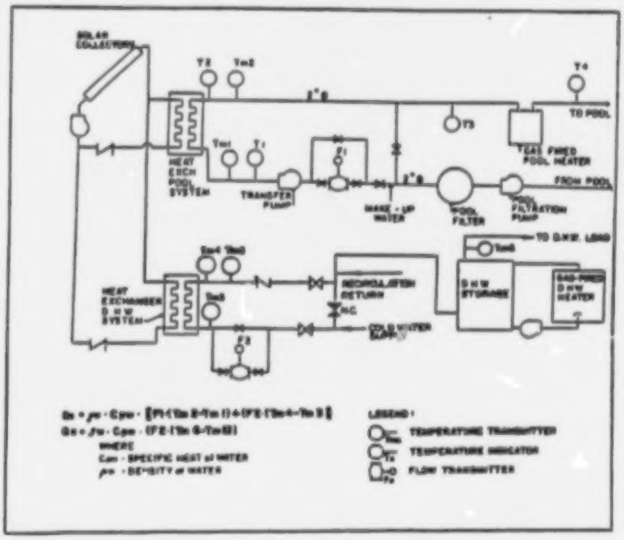
REPORT DATE: 85/09/10

PROJECT NAME: DRYDEN ACTIVITY COMPLEX
Dryden, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: V. Kameda
TELEPHONE: (807)223-2367

SERVICE: Swimming Pool Heating and Domestic Hot Water
OPERATING TEMPERATURES: 27 Degrees C inlet, 29 degrees C demand
COMMISSIONING DATE: April 1983 REPORTING PERIOD: Aug 84 to July 85


SOLAR COLLECTORS
T2
Tm2
T4
2" Ø
TO POOL
T3
GAS FIRED POOL HEATER
Tm1
T1
F1
HEAT EXCH POOL SYSTEM
TRANSFER PUMP
MAKE-UP WATER
2" Ø
POOL FILTER
POOL FILTRATION PUMP
FROM POOL
TO D.H.W. LOAD
Tm6
Tm4
Tm5
HEAT EXCHANGER D H W SYSTEM
Tm3
RECIRCULATION RETURN
N.C.
COLD WATER SUPPLY
F2
D H W STORAGE
GAS-FIRED D H W HEATER
WHERE
Cpw - SPECIFIC HEAT of WATER
ρw - DENSITY of WATER
LEGEND:
TEMPERATURE TRANSMITTER
TEMPERATURE INDICATOR
FLOW TRANSMITTER

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETRO-SUN
Collector Fluid - 58% propylene glycol, 42% water
Number of Collectors - 66 Area - 200 square meters
SOLAR STORAGE: Swimming pool
AUXILIARY HEATERS: Gas-fired pool heater (700,000 BTU/hour)
HEAT EXCHANGER: Alfa Laval P22VL
MONITORING INSTRUMENTS: Flow meters - 3" Neptune Green Seal, 2" Neptune Trident
Energy meters - Ontario Research Foundation Single Channel for pool solar energy delivered, Ontario Research Foundation, Dual Channel for DHW energy
Elapsed time meter - monitoring usage of auxiliary gas heater

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Dryden Activity Complex
Location: Dryden

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			6.40	3.91	Flow meter has been
			(10.31)	(0.00)	repaired.
SEP-84			11.20	92.67	System shutdown 84/09/04 to
			(39.37)	(64.50)	84/09/11 for pool repairs.
OCT-84			15.70	81.58	-
			(33.37)	(63.91)	
NOV-84			16.10	83.46	-
			(15.33)	(84.23)	
DEC-84			4.80	105.02	-
			(10.32)	(99.50)	
JAN-85			5.99	132.13	-
			(18.51)	(119.61)	
FEB-85			19.41	71.38	-
			(25.42)	(65.37)	
MAR-85			42.80	72.60	-
			(35.43)	(79.97)	
APR-85			33.50	81.75	-
			(35.50)	(79.75)	
MAY-85			26.20	159.66	-
			(44.23)	(141.63)	
JUN-85			25.50	57.18	-
			(41.75)	(40.93)	
JUL-85			47.80	23.75	-
			(42.72)	(28.83)	
Totals			255.40	965.09	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Site contact reports some problems with snow buildup on the collectors in winter.
- A site visit by the monitoring contractor found that the change gears in the flow meter were worn, causing improper meshing. The flow meter was repaired. (August/84)
- A second heat exchanger was added to this system in November, 1984 to provide DHW preheat. The DHW monitoring equipment was commissioned 850726.
- The solar heating system was shutdown for part of June for pool repairs.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Dryden Activity Complex
Location: Dryden

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	496		17.0	
SEP-84	360		11.2	
OCT-84	217		5.3	
NOV-84	120		-4.7	
DEC-84	109		-14.4	
JAN-85	96		-19.0	
FEB-85	252		-15.3	
MAR-85	403		-7.6	
APR-85	510		2.4	
MAY-85	605		10.1	
JUN-85	690		15.7	
JUL-85	651		18.7	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures required as system is on warranty.
- Approximately $60.00 was spent on parts for the flow meter in August 1984.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 210

REPORT DATE: 85/09/10

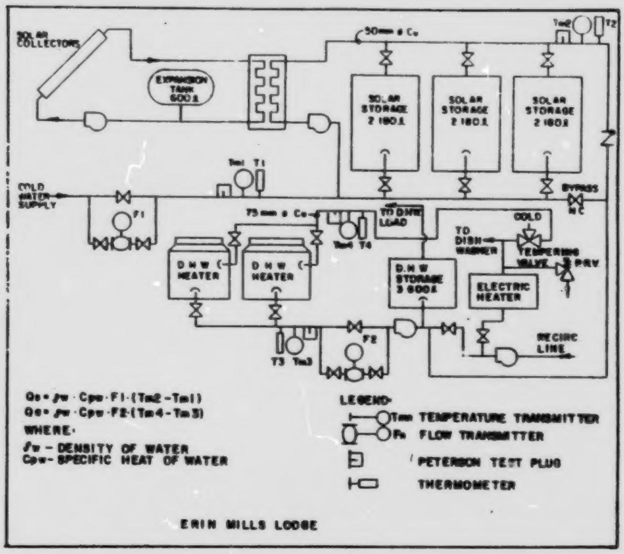
PROJECT NAME: ERIN MILLS LODGE
Mississauga, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Daniel Scully
Sunny Fidel
TELEPHONE:(416) 623-6700

SERVICE: Domestic Hot Water - Senior Citizen's Home
OPERATING TEMPERATURES: 14 Degrees C Inlet; 65 Degrees C
COMMISSIONING DATE: March 1, 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
EXPANSION TANK 600 ℓ
50 mm ø Cu
Tm2
T2
SOLAR STORAGE 2 180 ℓ
SOLAR STORAGE 2 180 ℓ
SOLAR STORAGE 2 180 ℓ
Tm1 T1
COLD WATER SUPPLY
F1
BYPASS
NC
75 mm ø Cu
TO DHW LOAD
Tm4 T4
COLD
TO DISH WASHER
TEMPERING VALVE
PRV
DHW HEATER
DHW HEATER
D.H.W STORAGE 3 600 ℓ
ELECTRIC HEATER
F2
T3 Tm3
RECIRC LINE
Qs = ρw · Cpw · F1 · (Tm2 - Tm1)
Qa = ρw · Cpw · F2 · (Tm4 - Tm3)
WHERE:
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND:
Tm TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
ERIN MILLS LODGE

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN
Collector Fluid - 50% propylene glycol, 50% water
Number of Collectors - 40 Area - 150 square meters
SOLAR STORAGE: 6540 litres
AUXILIARY HEATERS: Teledyne Laars, (2), gas fired, 1,466,000 Btu/hr
HEAT EXCHANGERS: Alpha laval, P22-VL
MONITORING INSTRUMENTS: Flow meters - Solar, Kent C-700, 1.5"
- Auxiliary, Kent TM-230, 2.0"
Energy meter - Rho Sigma RS 815 FP, (Dual), with channel for solar energy delivered, channel for auxiliary energy delivered

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 210

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Erin Mills Lodge
Location: Mississauga

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84			21.19	190910	-
SEP-84			12.43	108120	-
OCT-84			8.94	83280	-
NOV-84			13.58	133490	-
DEC-84			17.12	171410	-
JAN-85			11.23	202720	-
FEB-85			13.43	172510	-
MAR-85			15.62	185730	-
APR-85			19.66	181020	-
MAY-85			23.89	219970	-
JUN-85			23.03	204520	-
JUL-85			22.97	201410	-
Totals			203.69	2055090	

Units: Energy - Gigajoules, Water usage - Liters.

Comments on System Performance:

- Site contact reported failure of glycol pump coupling in October 1983. It was promptly replaced by the system contractor.
- This site has a low load which adversely affects system efficiency.
- The auxiliary flow meter failed, as a result data for auxiliary energy are unavailable. The water usage is recorded in its place.
- The site contact reports that a pressure relief valve on a storage tank is set for 125 psi, however the tank is rated for only 100 psi. This problem should be rectified immediatly as the mechanical equipment cannot be insured in its present state.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Erin Mills Lodge
Location: Mississauga

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		19.7	
SEP-84	420		16.0	
OCT-84	279		9.9	
NOV-84	150		4.3	
DEC-84	130		-1.9	
JAN-85	96		-5.0	
FEB-85	252		-4.4	
MAR-85	403		0.1	
APR-85	510		6.3	
MAY-85	620		11.5	
JUN-85	660		17.2	
JUL-85	682		20.1	

Training and Recent Activity of Site Personnel:

- Sonny Fidel attended a M. O. E. Solar Operator's Seminar Oct. 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures required as system is on warranty.

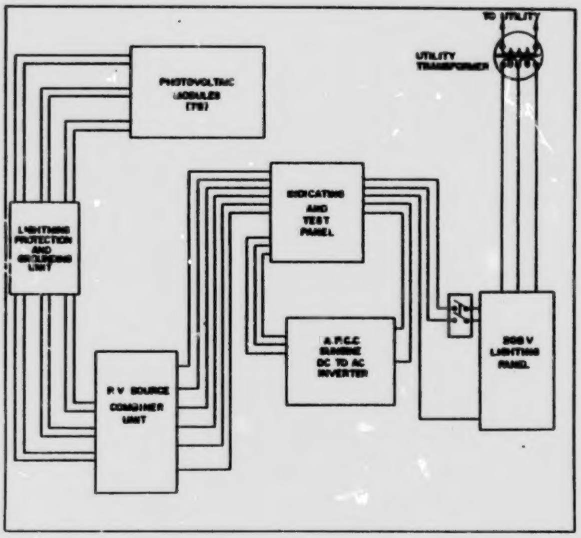
ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 355

REPORT DATE:	85/09/10	PAGE 1	
PROJECT NAME:	FUTURE POD, Ontario Place Toronto, Ontario	CONTACT:	Harry Chupa
		TELEPHONE:	(416) 965-4873

SERVICE: Photovoltaic, Utility Interactive, for 208V lighting panel

COMMISSIONING DATE: 84/08/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


TO UTILITY
UTILITY TRANSFORMER
PHOTOVOLTAIC MODULES (75)
INDICATING AND TEST PANEL
LIGHTNING PROTECTION AND GROUNDING UNIT
A.P.C.C. SUNSINE DC TO AC INVERTER
208 V LIGHTING PANEL
P.V. SOURCE COMBINER UNIT

SYSTEM DESCRIPTION:

SOLAR MODULES: Manufacturer: SOLAREX - 3000 watts total power in sunny conditions

Number of Modules - 75 Gross Area - 35.6 m2

SOLAR STORAGE: None

POWER CONDITIONING: American Power Conversion Corporation "Sunsine"
UI - 4000 Inverter with 208V auto transformer

MONITORING INSTRUMENTS: Output - D.C. Watt Hour and A.C. Watt Hour meters manufactured by Solarex

VARIABLES:
Qs - total useful solar energy delivered to the load

Site number: 355

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Future Pod, Ontario Place
Location: Toronto, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s) (DC)	Q(s) (AC)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85			83.788		-
FEB-85			147.060		-
MAR-85			307.182		-
APR-85			358.602		-
MAY-85			435.910		-
JUN-85			461.281		-
JUL-85			454.065		-
Totals			2247.888		

Units: Kilowatt-hours

Comments on System Performance:

- The monitoring equipment was installed by the system contractor.
- The A.C. watt-hour meter is malunctioning, as a result the reading is not available.
- A site visit by personnel from Ontario Hydro revealed the following deficiencies:
  - -14 gauge conductor connected to heavy current isolator without intermediate circuit breaker. This could present a fire hazard.
  - -no bilingual sign to indicate the P.V. system has 2 live circuits.
  - -white conductor is connected to a live phase, normally white is neutral.
- The A.C. watt-hour meter is displaying an incorrect reading. The system contractor is to repair the meter.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Future Pod, Ontario Place
Location: Toronto, Ontario

PREDICTED PERFORMANCE The performance of the system was modeled using the SUNRAY II computer program. Insolation data for the simulation was taken from the Insolation Data Manual published by SERI. The predictions for A.C. energy delivered to load per month are as follows:

(Units - A.C. Kilowatt hours)

JUL	437
AUG	404
SEP	347
OCT	286
NOV	182
DEC	179
JAN	232
FEB	273
MAR	361
APR	383
MAY	433
JUN	437
TOTAL	3954

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Future Pod, Ontario Place
Location: Toronto, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 125

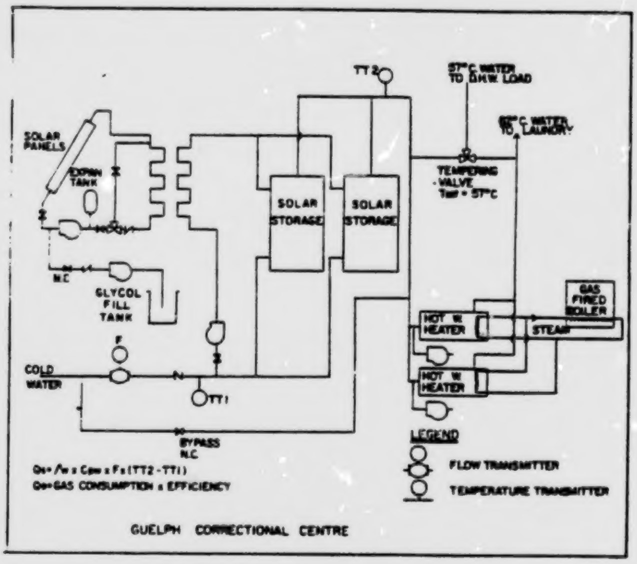
REPORT DATE: 85/09/10

PROJECT NAME: GUELPH CORRECTIONAL CENTRE
Guelph, Ontario.

CONTACT: B. Leader
TELEPHONE: (519)822-0020

SERVICE: Process and Domestic Hot Water
OPERATING TEMPERATURES: to 60 degrees Celsius
COMMISSIONING DATE: June 1982 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


TT2
57°C WATER TO DHW LOAD
85°C WATER TO LAUNDRY
SOLAR PANELS
EXPAN TANK
SOLAR STORAGE
SOLAR STORAGE
TEMPERING VALVE Tset = 57°C
N.C
GLYCOL FILL TANK
GAS FIRED BOILER
HOT W HEATER
STEAM
HOT W HEATER
F
COLD WATER
TT1
BYPASS N.C
Qs= Fw x Cpw x F x (TT2-TT1)
Qa=GAS CONSUMPTION x EFFICIENCY
LEGEND
FLOW TRANSMITTER
TEMPERATURE TRANSMITTER
GUELPH CORRECTIONAL CENTRE

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN Limited
Collector Fluid - 50% Propylene Glycol/Water; 80 panels, collector area 238 square metres
Arrangement: 8 rows, 10 panels in each
HEAT EXCHANGER: Alfa-Laval P22-V1 plate
SOLAR STORAGE: 2 - 4,540 litre storage tanks
AUXILIARY HEATERS: Two Gas Fired boilers deliver steam to two Hot Water Heaters
SERVICE: Domestic hot water
MONITORING INSTRUMENTATION:
- Neptune Crest 3 inch Water Meter
- Rho Sigma Energy Meter, RS 805 FP
- Rockwell Gas Flow Meter

VARIABLES:

Qs - total useful solar energy delivered to domestic hot water system
Qa - total auxiliary energy to domestic hot water system

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Guelph Correctional Centre
Location: Guelph, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			86.19	1431.68	-
			(57.68)	(1460.19)	
SEP-84			59.47	1219.00	-
			(47.30)	(1231.17)	
OCT-84			11.80	1195.20	-
			(37.42)	(1169.58)	
NOV-84			0.00	1119.40	Solar data unavailable due
			(10.07)	(1109.33)	to sensor failure.
DEC-84			15.30	1126.40	Sensor repaired in DEC.
			(2.28)	(1139.42)	
JAN-85			4.29	1116.36	-
			(12.33)	(1108.32)	
FEB-85			11.21	1035.53	-
			(25.12)	(1021.62)	
MAR-85			63.65	1123.77	-
			(38.00)	(1149.42)	
APR-85			75.73	1109.59	-
			(39.12)	(1146.20)	
MAY-85			76.90	1061.41	-
			(48.95)	(1089.36)	
JUN-85			80.44	1083.61	-
			(53.55)	(1110.50)	
JUL-85			84.49	1119.73	-
			(57.80)	(1146.42)	
Totals			569.47	13741.68	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The auxiliary energy usage will be calculated based on readings taken from an existing gas flowmeter which is installed on the gas line supplying gas to the DHW boilers.

- This system runs at approximately 60% efficiency during the summer months. This system's high efficiency is attributed to its high load.

- One collector glazing was broken, it has been replaced.

- The failed sensor was repaired 84/12/18. During this site visit the monitoring contractor found that the selector switch on the controller requires repair.

Site number: 125

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Guelph Correctional Centre
Location: Guelph, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		18.8	
SEP-84	420		15.0	
OCT-84	279		9.2	
NOV-84	150		2.5	
DEC-84	130		-4.1	
JAN-85	96		-7.2	
FEB-85	252		-6.5	
MAR-85	403		-1.9	
APR-85	510		5.8	
MAY-85	620		11.7	
JUN-85	660		17.4	
JUL-85	682		19.7	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Site contact reports that approximately $750.00 was spent on repairs and glycol replacements.
- A collector glazing was replaced at a cost of $325.00.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 213

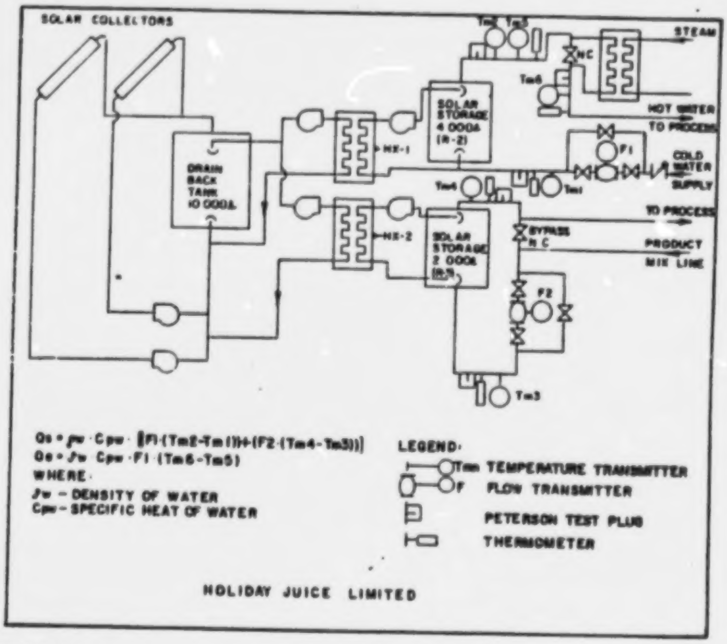
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: HOLIDAY JUICE LTD.
Windsor, Ontario

CONTACT: Albert Demers
Dan Kotwicki
TELEPHONE: (519) 252-4471

A Canada/Ontario Energy
Demonstration Project

SERVICE: Industrial Process
OPERATING TEMPERATURES: 10 Degrees C Inlet; 65 Degrees C Demand
COMMISSIONING DATE: October 1, 1983 REPORTING PERIOD: Aug 84 to July 85


SOLAR COLLECTORS
Tm2 Tm5
STEAM
NC
Tm6
SOLAR STORAGE 4 000L (R-2)
HOT WATER TO PROCESS
HX-1
F1
DRAIN BACK TANK 10 000L
COLD WATER SUPPLY
Tm4
Tm1
TO PROCESS
HX-2
SOLAR STORAGE 2 000L (R-3)
BYPASS N C
PRODUCT MIX LINE
F2
Tm3
Qs = ρw · Cpw · [F1·(Tm2-Tm1)+(F2·(Tm4-Tm3))]
Qa = ρw · Cpw · F1 · (Tm6-Tm5)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
HOLIDAY JUICE LIMITED

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN
Collector Fluid - Water
Number of Collectors - 108 Area - 324 square meters
SOLAR STORAGE: 16,000 litres
AUXILIARY HEATERS: Steam, via heat exchanger
HEAT EXCHANGERS: two Alpha Laval P-22 VL
MONITORING INSTRUMENTS: Flow meters - Kent TM2000, 2"
- Kent TM2000, 3"

Energy meters - Rho Sigma RS 815 FP Dual Channel
- Rho Sigma RS 805 FP Single Channel

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 213

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Holiday Juice
Location: Windsor

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			86.21 (60.64)	15.36 (40.93)	-
SEP-84			82.51 (54.12)	42.77 (71.16)	-
OCT-84			86.99 (47.33)	93.67 (133.33)	-
NOV-84			53.94 (16.19)	141.17 (178.92)	-
DEC-84			16.41 (7.31)	88.08 (97.18)	-
JAN-85					System shutdown due to a control sensor failure.
FEB-85					System shutdown.
MAR-85					System shutdown.
APR-85					System shutdown.
MAY-85			9.48 (9.48)	0.00 (0.00)	System back in operation 85/05/21.
JUN-85			21.66 (53.06)	56.60 (25.20)	-
JUL-85			17.38 (62.02)	87.74 (43.10)	-
Totals			374.58	525.39	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The site contact reports that the load increases dramatically during the cold weather.
- The solar heating system exhibits control problems
- The solar heating system was shut down for 1 week in Feb. due to a pump failure.
- The solar energy meter, which was shorted out by a water leak during February, was repaired. The meter was mounted inside a water proof enclosure.
- A sensor failure caused the system to be shutdown in JAN/85. Ten collectors were removed for repairs. The system was recommissioned in MAY/85.
- The energy meter was inadvertantly washed during plant clean-ups in DEC. and AUG. This caused the meter to be shorted out. The meter was repaired.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Holiday Juice
Location: Windsor

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Measured	Monthly Mean Ambient Temperature C Historical Mean	Monthly Mean Ambient Temperature C Measured
AUG-84	589		21.3	
SEP-84	420		17.4	
OCT-84	279		11.1	
NOV-84	150		4.4	
DEC-84	130		-1.9	
JAN-85	96		-4.9	
FEB-85	252		-3.8	
MAR-85	403		1.2	
APR-85	510		8.1	
MAY-85	620		14.2	
JUN-85	660		19.7	
JUL-85	682		22.2	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- A pump coupling had to be repaired at an approximate cost of $50.00 .
- $1900.00 has been spent on repairs to this system since its shutdown in 1985.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 216

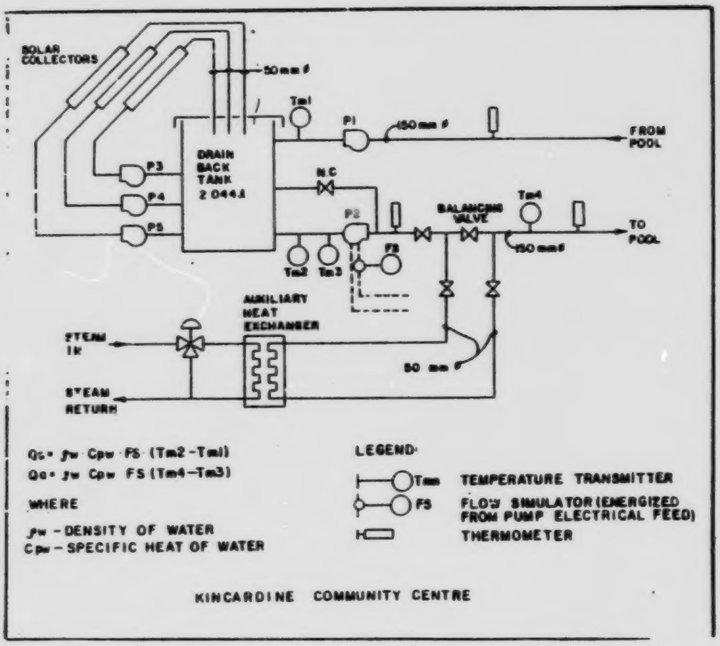
REPORT DATE: 85/09/10

PROJECT NAME: KINCARDINE COMMUNITY CENTRE
Kincardine, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Ronald Boulton
Susan Bushell
TELEPHONE: (519)396-3491

SERVICE: Pool Heating
OPERATING TEMPERATURES: 25 Degrees C Inlet; 28 Degrees C Demand
COMMISSIONING DATE: December 13, 1982 REPORTING PERIOD: Aug 84 to July 85


SOLAR COLLECTORS
50mm ø
Tm1
P1
150mm ø
FROM POOL
DRAIN BACK TANK 2 044 l
P3
P4
P5
N.C
P2
BALANCING VALVE
Tm4
TO POOL
150mm ø
Tm2
Tm3
FS
AUXILIARY HEAT EXCHANGER
STEAM IN
STEAM RETURN
50 mm
Qs = ρw Cpw FS (Tm2 - Tm1)
Qa = ρw Cpw FS (Tm4 - Tm3)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
FS FLOW SIMULATOR (ENERGIZED FROM PUMP ELECTRICAL FEED)
THERMOMETER
KINCARDINE COMMUNITY CENTRE

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: ENERSOURCE
Collector Fluid - Pool Water
Number of Collectors - 190 Area - 406 square meters
SOLAR STORAGE: 2,044 litre drain down tank, 681,300 litre pool
AUXILIARY HEATERS: Steam
HEAT EXCHANGERS: None

MONITORING INSTRUMENTS: O.R.F. Flow Simulator driven from pump #P2
O.R.F. Dual channel Energy Meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Kincardine Community Centre
Location: Kincardine,Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			26.66	47.32	-
			(73.98)	(0.00)	
SEP-84			0.00	81.12	System shutdown for repairs.
			(20.12)	(61.00)	
OCT-84			0.00	106.76	System shutdown for repairs.
			(30.43)	(76.33)	
NOV-84			0.77	81.29	-
			(2.79)	(79.27)	
DEC-84			1.37	145.50	-
			(1.17)	(145.70)	
JAN-85			1.02	145.86	-
			(21.44)	(125.44)	
FEB-85			1.15	111.57	-
			(34.94)	(77.78)	
MAR-85			19.41	90.52	-
			(45.84)	(64.09)	
APR-85			29.26	77.45	-
			(43.22)	(63.49)	
MAY-85			31.13	66.78	-
			(48.76)	(49.15)	
JUN-85			32.81	46.25	-
			(48.38)	(30.68)	
JUL-85			39.80	57.60	-
			(56.39)	(41.01)	
Totals			183.38	1058.02	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring system was installed in early January.

- Eight collectors were blown off during a storm on Dec 25,1983.

- The site contact reports that as of 84/05/07, 20 collectors had suffered wind damage.

- The solar heating system was shutdown for Oct-84 for repairs.

- A site visit 84/11/15 found that the structural repairs were completed and that the controller was being repaired. Calibration of the freeze stat is still required.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Kincardine Community Centre
Location: Kincardine,Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		18.5	
SEP-84	420		14.9	
OCT-84	279		9.4	
NOV-84	150		2.9	
DEC-84	130		-3.8	
JAN-85	96		-7.3	
FEB-85	252		-6.5	
MAR-85	403		-2.4	
APR-85	510		6.0	
MAY-85	620		11.5	
JUN-85	660		17.2	
JUL-85	682		19.3	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 340

REPORT DATE: 85/09/10 PAGE 1

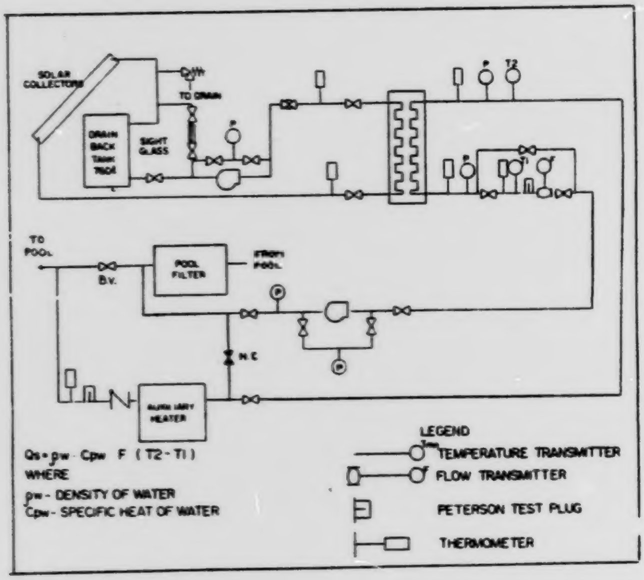
PROJECT NAME: LINDSAY AQUATORIUM
Lindsay, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Doug Moses
Sherry Cox
TELEPHONE: (705) 324-7837

SERVICE: Swimming pool heating
OPERATING TEMPERATURES: 27 Degrees C Inlet; 29 Degrees C Demand
COMMISSIONING DATE: 84/03/09 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
TO DRAIN
DRAIN BACK TANK
SIGHT GLASS
P
T2
T1
TO POOL
B.V.
POOL FILTER
FROM POOL
P
N.C
AUXILIARY HEATER
Qs = ρw · Cpw · F (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH S-48
Collector Fluid - Water
Number of Collectors - 40 Area - 119.00 m2
SOLAR STORAGE: Swimming Pool
AUXILIARY HEATERS: Gas fired heater
HEAT EXCHANGERS:
MONITORING INSTRUMENTS: 1 - 120V Elapsed Timer
Ontario Research Foundation single channel energy meter
2" Valmet flow meter
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Lindsay Aquatorium
Location: Lindsay, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84			15.27 (21.05)	69.60 (63.82)	-
OCT-84			10.12 (13.68)	77.58 (74.02)	-
NOV-84			1.63 (4.14)	120.20 (117.69)	-
DEC-84			0.00 (1.14)	142.24 (141.10)	System shutdown due to snow covering collectors.
JAN-85			0.00 (3.72)	177.09 (173.37)	System shutdown.
FEB-85			0.00 (9.31)	163.32 (154.01)	-
MAR-85			0.00 (17.56)	140.44 (122.89)	-
APR-85			12.93 (22.56)	122.98 (113.35)	-
MAY-85			26.25 (29.29)	63.86 (60.82)	-
JUN-85			32.53 (31.22)	34.76 (36.07)	-
JUL-85			33.16 (31.90)	30.01 (31.27)	-
Totals			131.89	1142.08	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 12, 1984.
- The solar heating system was shutdown due to an excessive snow covering on the collectors. Access to the collectors in the winter months is limited as a result the snow could not be removed.
- The controller collector temperature sensor is poorly installed. The wiring is open to the environment.
- The collector absorber coating is peeling on two of the collector panels. This follows a recent visit by the system contractor to repair the system.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Lindsay Aquatorium
Location: Lindsay, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.6	
SEP-84	420		14.9	
OCT-84	279		9.0	
NOV-84	150		2.2	
DEC-84	130		-5.8	
JAN-85	96		-8.9	
FEB-85	252		-7.4	
MAR-85	403		-2.5	
APR-85	510		5.8	
MAY-85	620		11.7	
JUN-85	660		17.3	
JUL-85	682		19.7	

Training and Recent Activity of Site Personnel:

- Don Butsom, Doug Moses, and George Walker attended a M. O. E. Solar Operator's Seminar Oct. 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 342

REPORT DATE: 85/09/10 PAGE 1

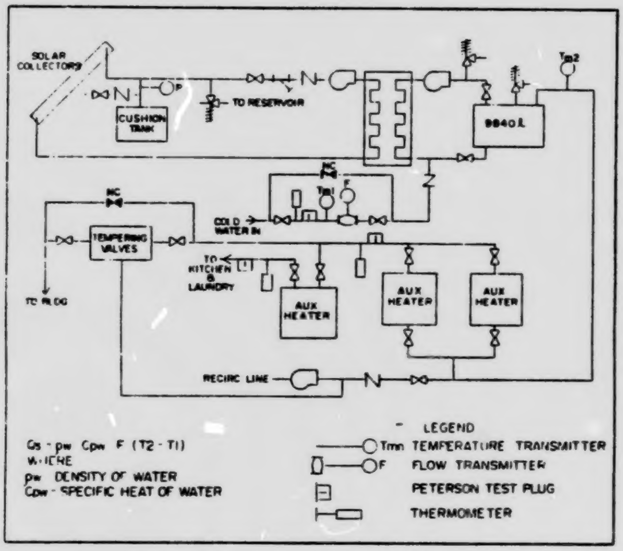
PROJECT NAME: LITTLE'S NURSING HOME
Ridgetown, Ontario

CONTACT: Dan Docherty
TELEPHONE: (519) 944-1131

A Canada/Ontario Energy
Demonstration Project

SERVICE: D.H.W. Heating
OPERATING TEMPERATURES: 10 Degrees C Inlet; 50 Degrees C Demand
COMMISSIONING DATE: 84/05/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
P
CUSHION TANK
TO RESERVOIR
9840 L
Tm2
NC
Tm1
F
COLD WATER IN
NC
TEMPERING VALVES
TO KITCHEN & LAUNDRY
TO BLDG
AUX HEATER
AUX HEATER
AUX HEATER
RECIRC LINE
LEGEND
Tmn TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
Qs - pw Cpw F (T2 - T1)
WHERE
pw DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLCAN 3001
    Collector Fluid - Water
    Number of Collectors - 60 Area - 135 m2
SOLAR STORAGE: 9080 litres
AUXILIARY HEATERS: 2 - Rudd GL85-200-2, 1 - Rudd GL50-60
HEAT EXCHANGERS: Armstrong W810-46 Shell and Tube
MONITORING INSTRUMENTS: Hersey Sun Meter
    Gas Flow Meter
VARIABLES:
    Qs - total useful solar heat delivered to the load
    Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Little's Nursing Home
Location: Ridgetown, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			4.13	4.15	-
			(8.28)	(0.00)	
SEP-84			10.13	17.47	-
			(20.59)	(7.01)	
OCT-84			6.73	21.80	-
			(17.72)	(10.81)	
NOV-84			6.87	20.90	-
			(7.53)	(20.24)	
DEC-84			7.79	23.96	-
			(4.16)	(27.59)	
JAN-85			7.04	31.02	-
			(8.72)	(29.34)	
FEB-85			10.66	23.68	-
			(13.39)	(20.95)	
MAR-85			14.94	19.85	-
			(18.54)	(16.25)	
APR-85			17.13	15.21	-
			(18.92)	(13.42)	
MAY-85			19.25	10.29	-
			(21.68)	(7.86)	
JUN-85			5.74	10.76	-
			(16.50)	(0.00)	
JUL-85			14.48	8.67	-
			(21.90)	(1.25)	
Totals			124.89	207.76	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 7, 1984.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Little's Nursing Home
Location: Ridgetown, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		20.7	
SEP-84	420		17.0	
OCT-84	279		11.0	
NOV-84	150		4.3	
DEC-84	130		-2.0	
JAN-85	96		-5.2	
FEB-85	252		-4.4	
MAR-85	403		0.6	
APR-85	510		7.3	
MAY-85	620		13.5	
JUN-85	660		19.0	
JUL-85	682		21.5	

Training and Recent Activity of Site Personnel:

- Daniel Docherty attended a M. O. E. Solar Operator's Seminar Oct. 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 344

REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: LONDON HOSPITAL LINEN SERVICES
London, Ontario

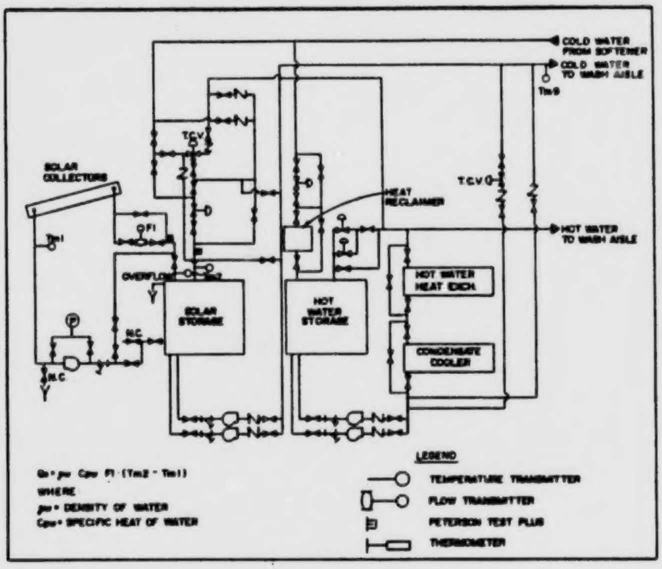
CONTACT: Morris Baetens
TELEPHONE: (519) 438-2925

A Canada/Ontario Energy
Demonstration Project

SERVICE: Hot Water Preheat for Laundry
OPERATING TEMPERATURES: 9 Degrees C Inlet: 36 Degrees C Demand

COMMISSIONING DATE: 85/04/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416) 965-3003


COLD WATER FROM SOFTENER
COLD WATER TO WASH AISLE
Tm3
T.C.V
SOLAR COLLECTORS
T.C.V
HEAT RECLAIMER
Tm1
FI
OVERFLOW
HOT WATER TO WASH AISLE
HOT WATER HEAT EXCH.
SOLAR STORAGE
HOT WATER STORAGE
N.C
N.C
CONDENSATE COOLER
LEGEND
Qs = ρw Cpw FI (Tm2 − Tm1)
WHERE
ρw = DENSITY OF WATER
Cpw = SPECIFIC HEAT OF WATER
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH
Collector Fluid - Water
Number of Collectors - 100 Area - 297 m2
SOLAR STORAGE: 27,000 litres
AUXILIARY HEATERS: Hot water heat exchanger and heat reclaimation equipment
HEAT EXCHANGERS: None
MONITORING INSTRUMENTS: Admic Controls Ltd., Remote Data Acquisition System, Cosmos 75 mm turbine flow meter

VARIABLES:
Os - total useful solar heat delivered to the load

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: London Hospital Linen Services
Location: London, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85			114.38	6029889	-
JUL-85			110.19	7107400	-
Totals			224.57	13137300	

Units: Energy = Gigajoules, Water Usage = Liters
Units: Gigajoules.

Comments on System Performance:

- The site contact reports that the absorber coating on at least 45 collector panels has started to peel off. The owner has not received any operators manuals as yet. A bypass valve in the system requires replacement.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: London Hospital Linen Services
Location: London, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
JUL-84	682		20.3	
AUG-84	589		19.5	
SEP-84	420		15.4	
OCT-84	279		9.4	
NOV-84	150		3.1	
DEC-84	130		-3.5	
JAN-85	96		-6.6	
FEB-85	252		-6.1	
MAR-85	403		-0.9	
APR-85	510		6.4	
MAY-85	620		12.4	
JUN-85	660		17.9	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 227

REPORT DATE: 85/09/10 PAGE 1

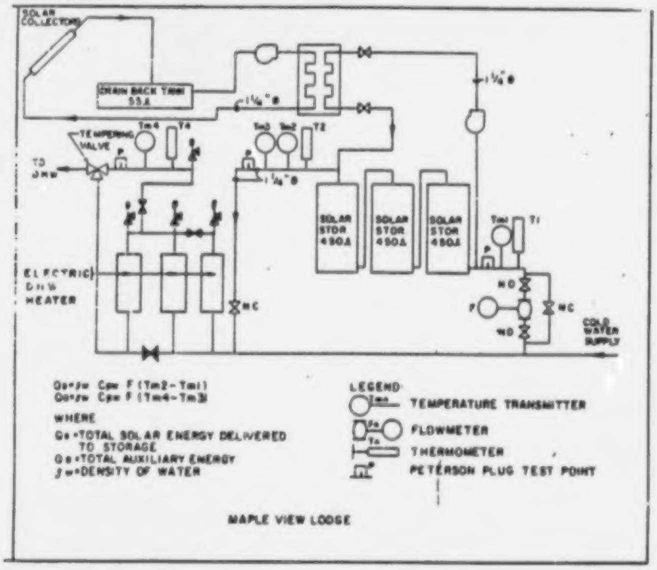
PROJECT NAME: MAPLEVIEW LODGE
Athens, Ontario

CONTACT: C. Gobeil
TELEPHONE: (613)342-4855

A Canada/Ontario Energy
Demonstration Project

SERVICE: Domestic Hot Water
OPERATING TEMPERATURES: 10 degrees C inlet; 60 degrees C demand
COMMISSIONING DATE: October 1982 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK 55A
1¼" Ø
1¼" Ø
1¼" Ø
TEMPERING VALVE
Tm4
T4
Tm3
Tm2
T2
TO DHW
P
SOLAR STOR 450A
SOLAR STOR 450A
SOLAR STOR 450A
Tm1
T1
ELECTRIC DHW HEATER
NC
NO
F
NC
NO
COLD WATER SUPPLY
Qs=ρw Cpw F (Tm2-Tm1)
Qa=ρw Cpw F (Tm4-Tm3)
WHERE
Qs=TOTAL SOLAR ENERGY DELIVERED TO STORAGE
Qa=TOTAL AUXILIARY ENERGY
ρw=DENSITY OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOWMETER
THERMOMETER
PETERSON PLUG TEST POINT
MAPLE VIEW LODGE

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH
Collector Fluid - Water
Number of Collectors - 10 Area - 29.7 square meters
SOLAR STORAGE: 1350 litres
AUXILIARY HEATERS: 450 litres oil fired, 3 Electrical DHW Heaters,
1350 litres total
HEAT EXCHANGERS: Tube and Shell

MONITORING INSTRUMENTS: Flow meter - 1" Kent C-700-FE
Energy meter - dual channel Rho Sigma measuring solar energy delivered and auxiliary energy delivered

VARIABLES:
Os - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: London Hospital Linen Services
Location: London, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
JUL-84	682		20.3	
AUG-84	589		19.5	
SEP-84	420		15.4	
OCT-84	279		9.4	
NOV-84	150		3.1	
DEC-84	130		-3.5	
JAN-85	96		-6.6	
FEB-85	252		-6.1	
MAR-85	403		-0.9	
APR-85	510		6.4	
MAY-85	620		12.4	
JUN-85	660		17.9	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 227

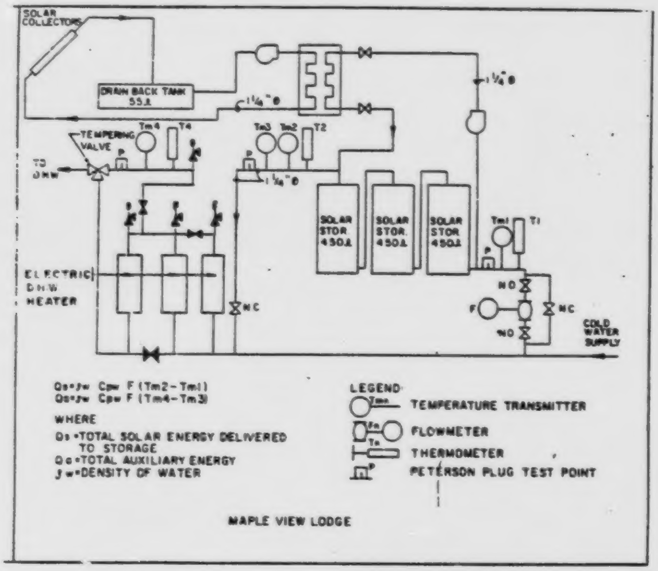
REPORT DATE: 85/09/10

PROJECT NAME: MAPLEVIEW LODGE
Athens, Ontario

CONTACT: C. Gobeil
TELEPHONE: (613)342-4855

A Canada/Ontario Energy Demonstration Project

SERVICE: Domestic Hot Water
OPERATING TEMPERATURES: 10 degrees C inlet; 60 degrees C demand
COMMISSIONING DATE: October 1982
REPORTING PERIOD: Aug 84 to July 85


SOLAR COLLECTORS
DRAIN BACK TANK 55 ℓ
1¼" Ø
1¼" Ø
1¼" Ø
TEMPERING VALVE
TO DHW
P
Tm4
T4
Tm3
Tm2
T2
SOLAR STOR 450 ℓ
SOLAR STOR 450 ℓ
SOLAR STOR 450 ℓ
Tm1
T1
ELECTRIC DHW HEATER
NC
NO
F
NC
NO
COLD WATER SUPPLY
Qs=ρw Cpw F (Tm2-Tm1)
Qa=ρw Cpw F (Tm4-Tm3)
WHERE
Qs =TOTAL SOLAR ENERGY DELIVERED TO STORAGE
Qa =TOTAL AUXILIARY ENERGY
ρw =DENSITY OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOWMETER
THERMOMETER
PETERSON PLUG TEST POINT
MAPLE VIEW LODGE

Ministry of Energy contact:
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH
Collector Fluid - Water
Number of Collectors - 10 Area - 29.7 square meters
SOLAR STORAGE: 1350 litres
AUXILIARY HEATERS: 450 litres oil fired, 3 Electrical DHW Heaters, 1350 litres total
HEAT EXCHANGERS: Tube and Shell

MONITORING INSTRUMENTS: Flow meter - 1" Kent C-700-FE
Energy meter - dual channel Rho Sigma measuring solar energy delivered and auxiliary energy delivered

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Mapleview Lodge
Location: Athens

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			5.28	9.88	-
			(5.96)	(9.20)	
SEP-84			8.45	6.82	-
			(5.42)	(9.85)	
OCT-84			3.77	12.01	-
			(4.99)	(10.79)	
NOV-84			1.66	13.43	-
			(2.31)	(12.78)	
DEC-84			1.17	14.27	-
			(1.54)	(13.90)	
JAN-85			1.03	13.91	-
			(2.73)	(12.21)	
FEB-85			1.64	11.42	-
			(3.68)	(9.38)	
MAR-85			4.96	10.10	-
			(4.79)	(10.27)	
APR-85			4.88	9.70	-
			(4.46)	(10.12)	
MAY-85			7.42	9.85	-
			(5.18)	(12.09)	
JUN-85			4.75	7.04	-
			(5.09)	(6.70)	
JUL-85			6.64	6.54	-
			(5.60)	(7.58)	
Totals			51.65	124.97	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Potential problem exists with pressure relief valves on drain back tank which could dump water onto wooden floor of attic, directly above occupant's rooms. The owner will correct this situation.

- System should be protected against cold fill at stagnation.

- The monitoring contractor could not locate a tempering valve, a very important component in this type of system.

- Two solar circulation pumps failed 84/07/09. The pumps were replaced 84/07/16 by the manufacturer at no cost to the system's owner.

Site number: 227 Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Mapleview Lodge
Location: Athens

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		19.9	
SEP-84	420		15.6	
OCT-84	279		9.6	
NOV-84	150		3.1	
DEC-84	130		-5.2	
JAN-85	96		-8.5	
FEB-85	252		-7.4	
MAR-85	403		-1.6	
APR-85	510		6.1	
MAY-85	620		13.2	
JUN-85	660		18.4	
JUL-85	682		21.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures required as system is on warranty.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 350

REPORT DATE: 85/09/10

PAGE 1

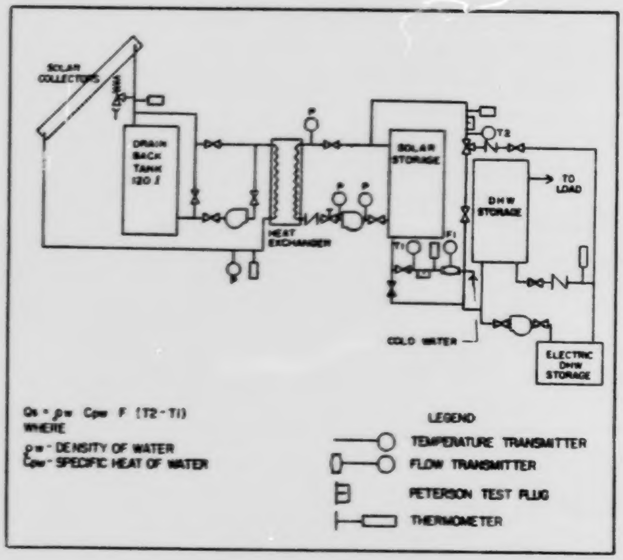
PROJECT NAME: MAVIS ROAD CAR WASH
Mississauga, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Randy Newton
TELEPHONE: (416) 273-5353

SERVICE: Hot water for car wash
OPERATING TEMPERATURES: 10 Degrees C Inlet; 55 Degrees C Demand
COMMISSIONING DATE: 83/09/01
REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
DRAIN BACK TANK 120 l
HEAT EXCHANGER
P
P
P
SOLAR STORAGE
T2
T1
F1
DHW STORAGE
TO LOAD
COLD WATER
ELECTRIC DHW STORAGE
Qs = ρw Cpw F (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTECH S-48
Collector Fluid - Water
Number of Collectors - 36 Area - 108 m2
SOLAR STORAGE: 3600 litres
AUXILIARY HEATERS: Raytherm Model 587 WTB
HEAT EXCHANGERS: Nixon Plate Type
MONITORING INSTRUMENTS: 24V Elapsed Timer
Hersey sunmeter

VARIABLES:
Os - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Mavis Road Car Wash
Location: Mississauga, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			16.01	24.88	-
			(27.97)	(12.92)	
SEP-84			11.42	28.16	-
			(23.91)	(15.67)	
OCT-84			7.93	48.86	-
			(22.15)	(34.64)	
NOV-84			8.18	42.99	-
			(9.67)	(41.50)	
DEC-84			6.91	99.76	-
			(6.29)	(100.38)	
JAN-85			5.11	101.56	-
			(11.73)	(94.94)	
FEB-85			13.63	89.94	-
			(17.50)	(86.07)	
MAR-85			25.96	73.00	-
			(24.25)	(74.71)	
APR-85			14.12	26.09	-
			(21.19)	(19.02)	
MAY-85			17.16	24.40	-
			(25.14)	(16.42)	
JUN-85			18.68	21.54	-
			(26.55)	(13.67)	
JUL-85			20.66	16.00	-
			(27.28)	(9.38)	
Totals			165.77	597.18	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned July 20, 1984.
- This system is being controlled manually, as there are problems with the contoller and a solenoid valve.
- Modifications were made to this site to convert it to a drain down system. The reconfigured system doesn't have a check valve before the system.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Mavis Road Car Wash
Location: Mississauga, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		19.7	
SEP-84	420		16.0	
OCT-84	279		9.9	
NOV-84	150		4.3	
DEC-84	130		-1.9	
JAN-85	96		-5.0	
FEB-85	252		-4.4	
MAR-85	403		0.1	
APR-85	510		6.3	
MAY-85	620		11.5	
JUN-85	660		17.2	
JUL-85	682		20.1	

Training and Recent Activity of Site Personnel:

- Randy Newton attended a M. O. E. Solar Operator's Seminar October 16, 1984.

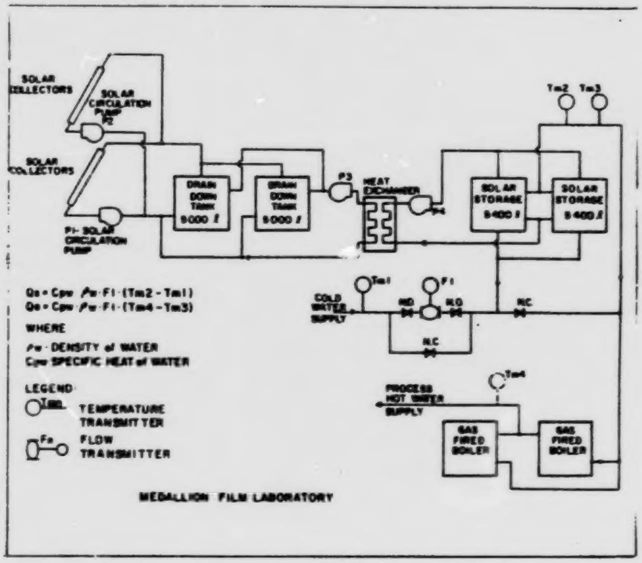
Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 137

REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: MEDALLION FILM LABORATORIES
Toronto, Ontario
CONTACT: Chris Turner
TELEPHONE: (416) 977-0019
SERVICE: Process water
OPERATING TEMPERATURES: 5 degrees C inlet, 48 degrees C demand
COMMISSIONING DATE: October 1982
REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
SOLAR CIRCULATION PUMP P2
SOLAR COLLECTORS
P1- SOLAR CIRCULATION PUMP
DRAIN DOWN TANK 5000 ℓ
DRAIN DOWN TANK 5000 ℓ
P3
HEAT EXCHANGER
P4
SOLAR STORAGE 5400 ℓ
SOLAR STORAGE 5400 ℓ
Tm2
Tm3
Tm1
F1
COLD WATER SUPPLY
NO
NO
NC
NC
Tm4
PROCESS HOT WATER SUPPLY
GAS FIRED BOILER
GAS FIRED BOILER
Qs = Cpw · ρw · F1 · (Tm2 - Tm1)
Qa = Cpw · ρw · F1 · (Tm4 - Tm3)
WHERE
ρw - DENSITY of WATER
Cpw SPECIFIC HEAT of WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
MEDALLION FILM LABORATORY

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN
Collector Fluid - Water (drain back system)
Number of Collectors - 141 Area - 336 square meters
SOLAR STORAGE: 10000 litres drain back
10800 litres solar storage
AUXILIARY HEATERS: 2 gas fired boilers (223 KW)
HEAT EXCHANGER: Alfa Laval P22VL; heat transfer area 6.48 square meters
MONITORING INSTRUMENTS: 2" Trident 8 Neptune flow meter
Dual ORF energy meter
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Medallion Film Laboratories
Location: Toronto

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			52.10	104.85	-
			(65.45)	(91.50)	
SEP-84			38.37	103.19	-
			(52.80)	(88.76)	
OCT-84			28.03	131.56	-
			(46.76)	(112.83)	
NOV-84			24.74	126.22	-
			(19.78)	(131.18)	
DEC-84			8.69	115.52	-
			(13.17)	(111.04)	
JAN-85			17.62	146.64	-
			(23.82)	(140.44)	
FEB-85			8.91	144.31	-
			(38.31)	(114.92)	
MAR-85			31.31	167.53	-
			(54.88)	(143.96)	
APR-85			24.85	179.82	-
			(56.28)	(148.39)	
MAY-85			58.20	99.99	-
			(57.74)	(100.45)	
JUN-85			62.10	100.30	-
			(58.30)	(104.10)	
JUL-85			77.37	137.95	-
			(70.41)	(144.91)	
Totals			432.29	1557.88	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The controller occasionally cycles erratically during periods of low energy gain.
- The minor collector coupling leaks which affected system operation have been repaired.
- The controller is not functioning properly. As a result pumps P3 and P4 run constantly.
- The control panel was not working for three weeks in July. The system was operated manually during this period. The controller has been repaired.
- This system is being operated manually due to control sensor failure. (85/02/13)
- Approximately one half of the array was shutdown due to a broken pipe caused by freezing. (APR. 85) The system has been repaired.

Site number: 137

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Medallion Film Laboratories
Location: Toronto

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Measured	Monthly Mean Ambient Temperature C Historical Mean	Monthly Mean Ambient Temperature C Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Approximately $150.00 was spent repairing the control panel.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 139

REPORT DATE: 85/09/10

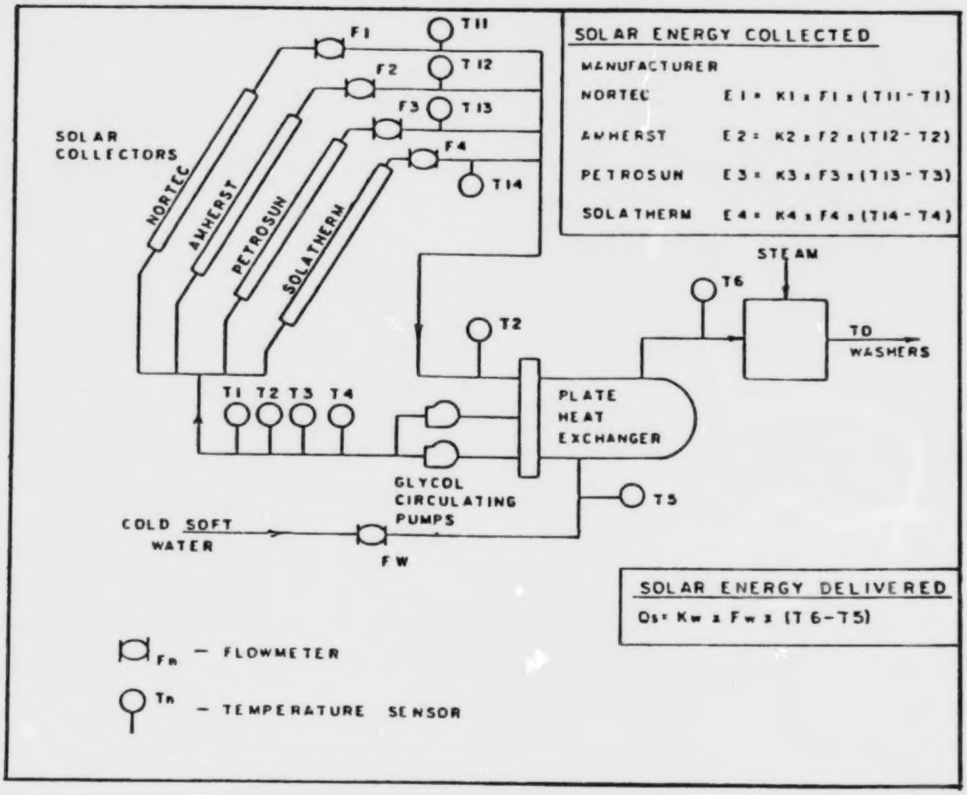
PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.
Hamilton, Ontario

CONTACT: Eric Shipley
(416)388-2117

A Canada/Ontario Energy
Demonstration Project

SERVICE: Hot water for laundry
COMMISSIONING DATE: September 1982

REPORTING PERIOD: Aug 84 to July 85


SOLAR COLLECTORS
NORTEC
AMHERST
PETROSUN
SOLATHERM
F1
F2
F3
F4
T11
T12
T13
T14
SOLAR ENERGY COLLECTED
MANUFACTURER
NORTEC E1 = K1 x F1 x (T11 - T1)
AMHERST E2 = K2 x F2 x (T12 - T2)
PETROSUN E3 = K3 x F3 x (T13 - T3)
SOLATHERM E4 = K4 x F4 x (T14 - T4)
STEAM
T6
T2
TO WASHERS
T1 T2 T3 T4
PLATE HEAT EXCHANGER
GLYCOL CIRCULATING PUMPS
T5
COLD SOFT WATER
FW
SOLAR ENERGY DELIVERED
Qs = Kw x Fw x (T6 - T5)
Fn - FLOWMETER
Tn - TEMPERATURE SENSOR

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

Service: Laundry Hot Water
Solar Storage: None
Solar Collector: Four manufacturers

Manufacturer	Collector Unit Area	# of Collectors	Collector Area (m2)
Nortec	1.95 m2	270	526.5
Amherst	2.80 m2	166	464.8
Petrosun	2.98 m2	174	520.3
Solatherm	2.30 m2	216	500.3
		Total Area	2011.9

ONTARIO MINISTRY OF ENERGY

MONTHLY SOLAR MONITORING REPORT

REPORT DATE: 85/09/10

PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.
Hamilton, Ontario.

COMMISSIONING DATE: Sept. 23, 1982 REPORTING PERIOD: Aug 84 to July 85

COLLECTOR FLUID: Glycol(50%) Water(50%)

COLLECTOR FLUID CIRCULATING PUMPS: 2-S.A. Armstrong #2D4380
Capacity: 145 USGPM @ 85ft. of water

HEAT EXCHANGER: Alfa Laval #P31-HX Plate Type

AUXILIARY ENERGY: Purchased Steam

MONITORING INSTRUMENTATION: The solar energy collected by each of the four manufacturer's arrays of collectors is monitored, as well as the total solar energy delivered to the laundry's hot water heating system. The arrangement of the energy meters is shown in the schematic. The auxiliary energy supplied by the purchased steam is obtained at the end of each of the laundry's thirteen twenty-eight day operating periods. The hot water use is the litres of water heated to 32 degrees Celsius by solar plus steam during the reporting period.

ONTARIO MINISTRY OF ENERGY

MONTHLY SOLAR MONITORING REPORT

REPORT DATE: 85/09/10

PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.

LOCATION: HAMILTON, ONTARIO

REPORTING PERIOD: Aug 84 to July 85

EXPECTED PERFORMANCE: The feasibility study for the project predicted that the solar system would contribute 7700 GJ annually to the hot water heating system, based on a total collector area of 2500 square meters. The consultant's predictions, corrected for the "as built" total collector area, (2012 square meters), are as follows:

(Units: Energy - gigajoules/Temperatures - C)

AUG	894
SEP	664
OCT	406
NOV	163
DEC	93
JAN	237
FEB	293
MAR	484
APR	623
MAY	711
JUN	764
JUL	868

TOTAL = 6200

The feasibility study predictions were based on a load of 581,000 litres/day of hot water use, and yearly minimum and maximum water main temperatures of 7 degrees Celsius and 13 degrees Celsius, respectively.

ONTARIO MINISTRY OF ENERGY

MONTHLY SOLAR MONITORING REPORT

REPORT DATE: 85/09/10 PAGE 4

PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.

LOCATION: HAMILTON, ONTARIO.

REPORTING PERIOD: Aug 84 to July 85

DATA

(UNITS: Energy - gigajoules / Temperatures - C / water usage-litres)

	Qs(N)	Qs(A)	Qs(P)	Qs(S)	Qs Total (lbs. of steam saved)	Qa	Water Usage
AUG	81.39	55.42	113.90	96.41	346,658	4306.62	12,362,107
SEP	64.21	0.0	81.82	75.73	220,069	4129.46	8,924,386
OCT	49.40	0.0	64.59	70.96	177,623	4953.13	9,293,105
NOV	27.69	0.0	60.48	56.53	143,741	5507.46	5,101,325
DEC	16.11	0.0	36.29	27.72	79,779	5699.87	3,716,895
JAN	14.11	0.0	39.93	34.33	89,954	7168.60	4,681,491
FEB	27.42	0.0	48.01	55.70	144,696	6414.82	5,732,585
MAR	45.92	0.0	97.82	78.85	245,617	6426.33	9,625,025
APR	58.15	0.0	127.39	106.55	322,308	5496.58	11,320,655
MAY	71.13	0.0	149.51	125.82	382,303	4864.90	13,114,914
JUN	85.88	0.0	149.20	127.59	400,190	4454.64	12,330,176
JUL	92.74	0.0	164.38	140.38	405,612	4260.91	12,928,163

(N)-Nortec
(A)-Amherst
(P)-Petrosun
(S)-Solatherm

Comments:

1. Six Nortec collectors with vacuum failure were replaced in Oct/83.
2. Flow meter on Solatherm operating intermitently during Apr/83.
3. The flow rate through the Nortec arrays was found to be approximately 12% less than the design value recommended by the manufacturer.
4. The glycol system is to be flushed Dec. 5/83 following the discovery of debris in the heat exchanger, found during a tear-down in Nov/83.
5. The glycol flow rates will be rebalanced after the system is flushed to deliver adequate flow to the various collector arrays.

**6. Solatherm flow meter failed on October 30, 1983. The unit was repaired in November.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

REPORT DATE: 85/09/10 PAGE 5

PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.

LOCATION: HAMILTON, ONTARIO

REPORTING PERIOD: Aug 84 to July 85

Comments Continued:

***7. Water usage data previous to November, 1983, is only the water used when there is an energy gain from the solar system. The subsequent data is the total water usage.

8. An indepth study has revealed that the solar monitoring temperature sensors located outside were subject to some losses to the ambient, during extremely cold weather conditions. The monitoring contractor has alleviated this problem.

****9. The monitoring equipment was only operational for a period of 13 days in December, as the flow meters had to be removed and recalibrated during the flushing of the glycol loop. The Auxiliary Energy data is for the entire month.

10. Heat Exchanger effectiveness was tested on 84/02/10 and found to be approximately 0.70.

11. Four Amherst panels were replaced in February and one was found to be defective.

12. The site contact reports leakage problems with some of the Amherst collector couplings.

13. The system mechanical contractor inadvertantly left the solar pump on manual operation after doing repairs to solar panels on 84/02/06. As a result, the solar heat exchanger froze overnight. However, the solar heat exchanger was not permanently damaged.

*****14. The high temperature sensors for the Petrosun and Amherst arrays failed in February causing the respective energy meters to see a large temperature differential. The energy values for these sites, for Feb 83, are based on a statistical analysis of past data and the total energy delivered to the process water for the month.

15. Flushing the heat exchanger has resulted in a dramatic improvement in Q(s)(total) compared to 1983.

16. The solar insolation for the month of May was approximately 20% less than the historical average.

17. Sixteen Amherst collector panels will be replaced by fourteen Petro-Sun collectors.

18. Two sensors failed (Nortec and Amherst arrays). They have been replaced. As a result, the energy results for JUN and JUL for the Nortec and Amherst arrays are based on a statistical analysis of past data and data collected since the repair of the sensors.

19. The glycol concentration has been diluted until the leaks in the system are fixed. Upon repair the glycol/water will be brought back to the proper concentration.

20. The complete Amherst array was shutdown at the end of August due to leaks. The Amherst array is to be replaced by another manufacturer's product.

21. A glycol/water sample from this site was analysed and was found to be 24% glycol. This strength provides freeze protection to -12 degrees Celsius.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

REPORT DATE: 85/09/10

PROJECT NAME: MOHAWK HOSPITAL SERVICES INC.

LOCATION: HAMILTON, ONTARIO

REPORTING PERIOD: Aug 84 to July 85

Comments Continued:

22. Glycol was added to the system to bring the glycol/water mixture to 50/50.
23. A temperature sensor on the Nortec Array failed in September. It has been replaced. As a result the energy data for the Nortec array are based on a statistical analysis of past data.
24. Temperature sensors failed on the Petrosun and Solartherm arrays at the end of October. As a result the energy data for these arrays for October and November are based on a statistical summary of past data.
25. The flowmeter pulser for the Petrosun array failed in November. It has been repaired.
26. The flow meter gear drive for the Petrosun array failed in December. As a result the energy data for the Petrosun array for December and January is based on a statistical summary of past data. The flow meter has been repaired.
27. A remote alarm indicating low pressure and/on off status has been installed on this system.
28. During a site visit on June 20/85, it was discovered that the bypass valve for the Nortec array flow meter was partially open. This resulted in an error in the energy data for Oct. to Feb. The data have been adjusted accordingly.
29. During the site visit on June 20/85, it was discovered that a temperature sensor on the Nortec array had failed. As a result the Nortec energy data for Mar. & Apr. and May are based on the glycol flow readings and a statistical summary of past data. The monitoring equipment was repaired.

Site Number: 139

Report Date: 85/09/10

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: MOHAWK HOSPITAL SERVICES INC.
Location: Hamilton, Ontario

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Abient Temperature C Historical Mean	Measured
Jul 84	682		20.0	
Aug 84	589		20.0	
Sep 84	420		15.7	
Oct 84	279		9.4	
Nov 84	150		3.4	
Dec 84	130		-3.4	
Jan 85	96		-6.4	
Feb 85	252		-6.3	
Mar 85	403		-0.8	
Apr 85	510		6.1	
May 85	620		12.6	
Jun 85	660		18.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during previous 12 months

- Site contact reports that $2,240.00 was spent in September on controlling weed growth between the collector arrays.
- Site contact reports that $402.00 was spent replacing glycol which was lost when the defective Amherst collector was installed.
- Site contact reports that $355.00 was spent replacing glycol which was lost from a leaking coupling.
- Site contact reports that $1691.00 was spent replacing glycol which was lost from a split coupling. (December '84)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 140

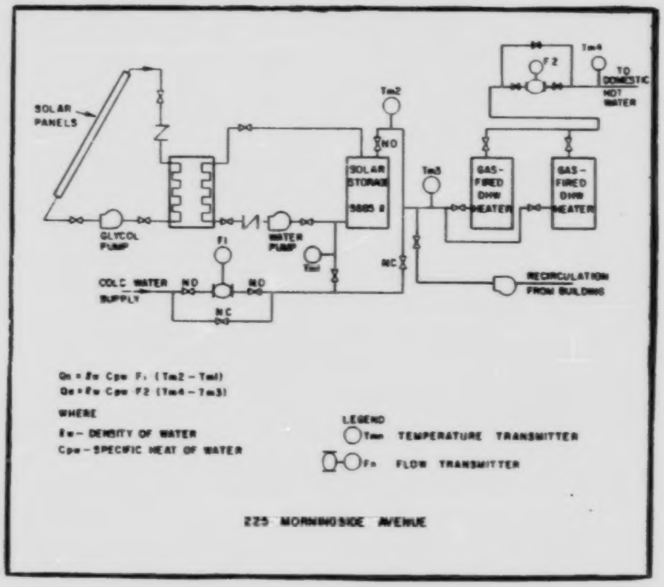
REPORT DATE: 85/09/10

PROJECT NAME: 225 MORNINGSIDE AVENUE,
Scarborough, Ontario.

CONTACT: Mrs. Ritchie
TELEPHONE:416-284-3822

SERVICE: Domestic hot water.
OPERATING TEMPERATURES: 5 degrees C inlet, 60 degrees C demand
COMMISSIONING DATE: November 1981 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR PANELS
GLYCOL PUMP
WATER PUMP
SOLAR STORAGE 5685 ℓ
Tm2
NO
Tm3
Tm1
F1
NC
COLD WATER SUPPLY
NO
NO
NC
GAS-FIRED DHW HEATER
GAS-FIRED DHW HEATER
F2
Tm4
TO DOMESTIC HOT WATER
RECIRCULATION FROM BUILDING
Qs = ρw Cpw F1 (Tm2 − Tm1)
Qa = ρw Cpw F2 (Tm4 − Tm3)
WHERE
ρw − DENSITY OF WATER
Cpw − SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
225 MORNINGSIDE AVENUE

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETROSUN
Collector Fluid - 50% glycol and water
Number of Collectors - 43 Area - 125 square meters
SOLAR STORAGE: 5685 litres
AUXILIARY HEATERS: 2 Gas-fired boilers
HEATER EXCHANGER: Manufacturer: Alfa Laval Type: Plate type P22-HBL
MONITORING INSTRUMENTS: - O.R.F. Dual Channel Energy Meter
- 2" Kent Cold Water Flow Meter
- 2" Kent Hot Water Flow Meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 140

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: 225 Morningside Avenue
Location: Scarborough, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			30.27 (27.22)	28.40 (31.45)	-
SEP-84			24.64 (22.41)	26.29 (28.52)	-
OCT-84			17.68 (13.33)	0.00 (4.35)	Auxiliary data unavailable due to flow meter failure.
NOV-84			9.84 (6.23)	0.00 (3.61)	-
DEC-84			8.94 (5.38)	0.00 (3.56)	-
JAN-85			6.84 (6.24)	0.00 (0.60)	-
FEB-85			16.09 (9.98)	0.00 (6.11)	-
MAR-85			23.57 (15.04)	0.00 (8.53)	-
APR-85			24.45 (15.82)	0.00 (8.63)	-
MAY-85			29.72 (20.03)	0.00 (9.69)	-
JUN-85			34.27 (22.65)	0.00 (11.62)	-
JUL-85			34.02 (23.95)	0.00 (10.07)	-
Totals			260.33	54.69	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Solar heating system is fully operational.

- New instrumentation commissioned in November, 1983.

- Monitoring equipment was calibrated on Dec.6,83.

- Three collectors were vandalized. They have since been repaired.

- Auxiliary flow meter failure has resulted in Erroneous data. The existing natural gas flow meter will be used for the present.

- The auxiliary flow meter was eroded by solids in the recirculating hot water system. It has been removed for repairs.

Site number: 140

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: 225 Morningside Avenue
Location: Scarborough, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: 225 Morningside Avenue
Location: Scarborough, Ontario

Monthly Hot Water/Natural Gas Consumption

Month	Hot Water (litres)	Natural Gas (cubic meters)
AUG-84	273,321	4332.1
SEP-84	491,270	4757.8
OCT-84	709,300	5341.6
NOV-84	479,500	5365.3
DEC-84	445,800	6106.9
JAN-85	347,050	6637.4
FEB-85	628,060	5721.0
MAR-85	668,297	6430.4
APR-85	490,099	5524.6
MAY-85	595,938	5708.8
JUN-85	605,834	5532.8
JUL-85	488,483	4850.0
TOTALS	6,222,952	6,6308.7

Comments:
- Hot water consumption is from the flow meter labeled F1 on the schematic.
- Natural gas consumption is for the two gas fired DHW heaters only.

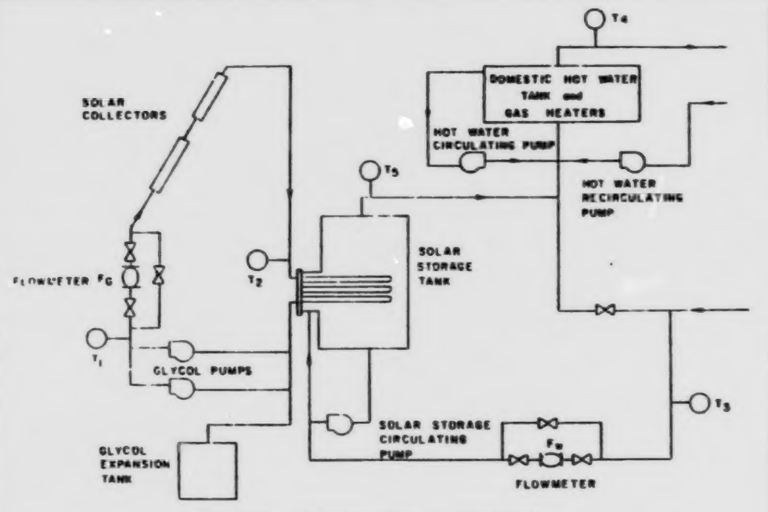
ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 142

REPORT DATE: 85/09/10 PAGE 1.

PROJECT NAME: ONTARIO CORRECTIONAL INSTITUTE
Brampton, Ontario.

CONTACT: D. Allen
TELEPHONE:(416)457-7050

COMMISSIONING DATE: June 1980 REPORTING PERIOD: Aug 84 to July 85


T4
DOMESTIC HOT WATER TANK and GAS HEATERS
SOLAR COLLECTORS
HOT WATER CIRCULATING PUMP
T5
HOT WATER RECIRCULATING PUMP
SOLAR STORAGE TANK
T2
FLOWMETER FG
T1
GLYCOL PUMPS
T3
SOLAR STORAGE CIRCULATING PUMP
FW
FLOWMETER
GLYCOL EXPANSION TANK

ONTARIO CORRECTIONAL INSTITUTE
SOLAR ASSISTED HOT WATER HEATING SYSTEM

Ministry of
Energy contact
Tom Markowitz
(416)965-3003

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: TEMSPEC Limited
Collector Fluid - 50% Propylene Glycol/Water; 56 panels, collector area 94.89 square metres
Arrangement: 28 pairs of panels in series in two banks
HEAT EXCHANGER: A.S.Leach Model 8-4-87 JWSX SIZE: Transfer area 5.2 m2
SOLAR STORAGE: 1 - 7570 litre tank with circulating pump
AUXILIARY HEATERS: Two gas fired hot water heaters
Capacity: 87.9 KW each
SERVICE: Circulating Domestic Hot Water
MONITORING INSTRUMENTATION: Level B monitoring system provided by Ont. Research Foundation with MATER data recording variables recorded.

Qi-Total Incident Solar Energy
Qs-Solar Energy Delivered to load
Qa-Auxiliary (gas) Heat Supplied
Tamb-Ambient Temperature (at Collector)
Qc-Total Solar Energy Transferred to solar storage tank
Tst-Solar storage tank temperature
S-Glycol Pump Motor 'on-time'

EXPECTED PERFORMANCE: (based on Ministry of Energy Project #3325 Solar Domestic Hot Water Heating Feasibility - Ontario Correctional Institute July 1978)

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Total Energy Demand:	850	74	76	77	75	75	70	70	68	64	65	68	71
Solar Energy:	260	--	--	--	--	--	--	--	--	--	--	--	--
Solar Fraction:	0.31	--	--	--	--	--	--	--	--	--	--	--	--

(Energy Units: gigajoules)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Ontario Correctional Institute
Location: Brampton, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84	49.11	26.82	29.92 (20.15)	101.78 (111.55)	-
SEP-84	40.45	19.91	22.19 (17.75)	98.57 (103.01)	-
OCT-84	31.63	16.03	18.80 (15.62)	121.93 (125.11)	-
NOV-84	23.79	9.83	12.08 (5.87)	118.47 (124.68)	-
DEC-84	11.97	4.46	6.37 (3.02)	137.31 (140.67)	-
JAN-85	26.25	8.08	9.74 (7.06)	158.26 (160.94)	-
FEB-85	30.26	11.01	14.07 (10.89)	153.41 (156.59)	-
MAR-85	50.19	21.71	25.14 (15.02)	164.95 (175.07)	-
APR-85	44.36	21.74	25.13 (14.46)	139.19 (149.86)	-
MAY-85	53.07	27.94	31.76 (16.99)	131.64 (146.41)	-
JUN-85	60.56	26.34	29.59 (17.93)	111.61 (123.27)	-
JUL-85	44.33	29.28	33.07 (19.48)	99.46 (113.05)	-
Totals	465.97	223.15	257.86	1536.58	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- A level B monitoring report covering the period from February 1981 to January 1982 has been prepared by the Ontario Research Foundation.
- Solar monitoring instrumentation was checked by O.R.F. in July ,1983.
- The problem with Q(c) being less than Q(s) can not be totally atributed to ambient gain.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Ontario Correctional Institute
Location: Brampton, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.9	
SEP-84	420		14.8	
OCT-84	279		8.8	
NOV-84	150		2.8	
DEC-84	130		-4.1	
JAN-85	96		-7.3	
FEB-85	252		-6.6	
MAR-85	403		-1.5	
APR-85	510		5.8	
MAY-85	620		11.6	
JUN-85	660		16.9	
JUL-85	682		19.8	

Training and Recent Activity of Site Personnel:

- D.W. Allen attended a M.O.E. Solar Operator Seminar on March 15,1984 .
- Doug Allen attended a Ministry of Energy Solar Operator's Seminar October 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures required.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 360

REPORT DATE: 85/09/10 PAGE 1

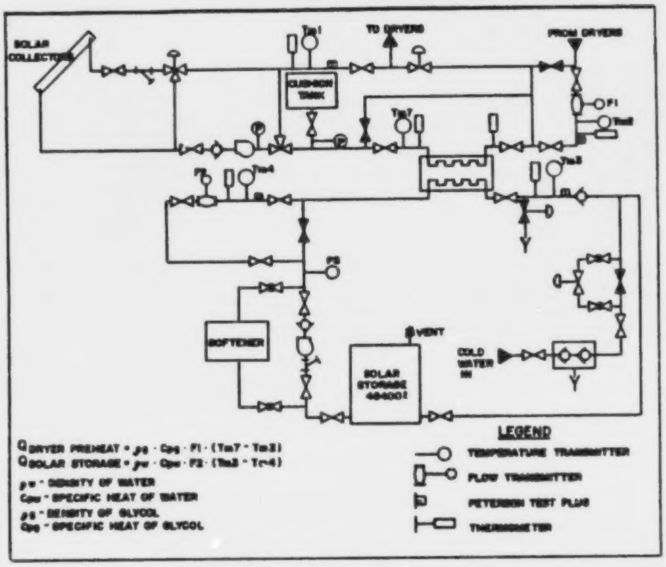
PROJECT NAME: OTTAWA REGIONAL HOSPITAL LINEN SERVICE, OTTAWA, ONTARIO

CONTACT: John Mavroudis
TELEPHONE: (613) 745-7057

A Canada/Ontario Energy Demonstration Project

SERVICE: Dryer Preheat
OPERATING TEMPERATURES: Degrees C Inlet; Degrees C Demand
COMMISSIONING DATE: 85/03/15 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416) 965-3003


SOLAR COLLECTORS
Tm1
TO DRYERS
FROM DRYERS
CUSHION TANK
F1
Tm2
Tm7
Tm3
F2
Tm4
F3
SOFTENER
VENT
SOLAR STORAGE 45400l
COLD WATER IN
$Q_{DRYER\ PREHEAT} = \rho g \cdot Cpg \cdot F1 \cdot (Tm7 - Tm2)$
$Q_{SOLAR\ STORAGE} = \rho w \cdot Cpw \cdot F2 \cdot (Tm3 - Tm4)$
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
ρg - DENSITY OF GLYCOL
Cpg - SPECIFIC HEAT OF GLYCOL
LEGEND
TEMPERATURE TRANSMITTER
FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: GENERAL SOLAR
Collector Fluid - Glycol
Number of Collectors - 18 Area - 847 m2
SOLAR STORAGE: 45,400 litres
AUXILIARY HEATERS:
HEAT EXCHANGERS:
MONITORING INSTRUMENTS: Admic Controls Ltd., Remota Data Acquisition System

VARIABLES:
Os - total useful solar heat delivered to the load

Site number: 360
Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Ottawa Regional Hospital Linen
Location: Ottawa, Ontario
Dryer Preheat

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85			85.22		-
JUL-85					System shutdown.
Totals			85.22		

Units: Gigajoules.

Comments on System Performance:

- The solar heating system has been shutdown.

Site number: 360

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Ottawa Regional Hospital Linen
Location: Ottawa, Ontario
Solar Storage
Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85		87.53	25.74		-
JUL-85					System shutdown.
Totals		87.53	25.74		

Units: Gigajoules.

Comments on System Performance:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Ottawa Regional Hospital Linen
Location: Ottawa, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		19.4	
SEP-84	420		14.6	
OCT-84	279		8.5	
NOV-84	150		1.6	
DEC-84	130		-7.5	
JAN-85	96		-10.8	
FEB-85	252		-9.5	
MAR-85	403		-2.9	
APR-85	510		5.7	
MAY-85	620		12.8	
JUN-85	660		18.1	
JUL-85	682		20.6	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 222

REPORT DATE: 85/09/10 PAGE 1

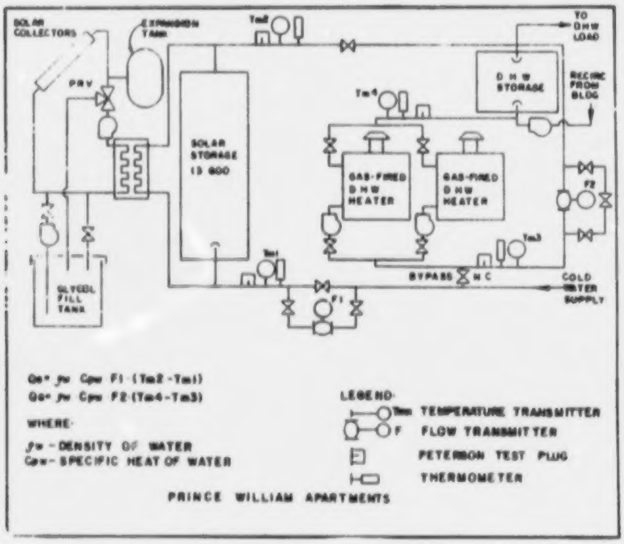
PROJECT NAME: PRINCE WILLIAM APARTMENTS
Belleville, Ontario

CONTACT: Wilf Smith
TELEPHONE: (613)968-6574

A Canada/Ontario Energy
Demonstration Project

SERVICE: Domestic Hot Water
OPERATING TEMPERATURES: 10 Degrees C Inlet; 55 Degrees C Demand
COMMISSIONING DATE: May 1, 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
EXPANSION TANK
PRV
Tm2
TO DHW LOAD
DHW STORAGE
RECIRC FROM BLDG
Tm4
SOLAR STORAGE 13 600
GAS-FIRED DHW HEATER
GAS-FIRED DHW HEATER
F2
Tm3
Tm1
BYPASS N C
COLD WATER SUPPLY
F1
GLYCOL FILL TANK
Qs= ρw Cpw F1 (Tm2-Tm1)
Qa= ρw Cpw F2 (Tm4-Tm3)
WHERE:
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND:
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
PRINCE WILLIAM APARTMENTS

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUNRAY
Collector Fluid - 50% Propylene glycol/50% water
Number of Collectors - 80 Area - 233 square meters
SOLAR STORAGE: 14,000 litres
AUXILIARY HEATERS: two gas fired DHW heaters
HEAT EXCHANGERS: Alfa Laval plate type
MONITORING INSTRUMENTS: Flow meters - Kent C-700, 1.5"
- Kent TM2000, 1.5"
Energy Meter - Rho sigma RS 815 FP
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Prince William Apartments
Location: Belleville

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			0.00 (9.52)	9.52 (0.00)	-
SEP-84			0.00 (9.21)	9.21 (0.00)	-
OCT-84			2.43 (13.00)	10.57 (0.00)	System was restarted 84/10/25.
NOV-84			10.18 (15.49)	18.30 (12.99)	-
DEC-84			3.84 (11.58)	19.98 (12.24)	-
JAN-85			1.36 (13.70)	13.71 (1.37)	-
FEB-85			3.56 (13.61)	10.05 (0.00)	-
MAR-85			5.90 (14.58)	8.68 (0.00)	-
APR-85			4.18 (10.69)	6.51 (0.00)	-
MAY-85			13.19 (20.25)	7.06 (0.00)	-
JUN-85					Data unavailable due to system shutdown.
JUL-85					-
Totals			44.64	113.59	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Site contact reports that system has been subject to airlocks since start up.
- The site contact feels that the Qa flowmeter is too restrictive and has been bypassed. The system was tested by the monitoring contractor and was found to have no detectable pressure drop across the Qa flowmeter. One of the auxiliary heater circulation pumps is suspect.
- The leaks in this system were repaired in Oct/84. This system continues to have airlock problems resulting in a loss of flow to the collectors.
- The suspect auxiliary heater circulation pump was repaired and is now operating properly.
- The solar heating system was shutdown due to a broken pipe. The pipe was repaired.(JUN/85)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Prince William Apartments
Location: Belleville

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		20.2	
SEP-84	420		15.8	
OCT-84	279		9.6	
NOV-84	150		3.4	
DEC-84	130		-4.4	
JAN-85	96		-7.5	
FEB-85	252		-6.5	
MAR-85	403		-1.0	
APR-85	510		6.6	
MAY-85	620		12.9	
JUN-85	660		17.2	
JUL-85	682		21.1	

Training and Recent Activity of Site Personnel:

- Wilfred Smith attended a M.O.E. Solar Operator's Seminar on Mar 15,1984 .

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 221

REPORT DATE: 85/09/10 PAGE 1

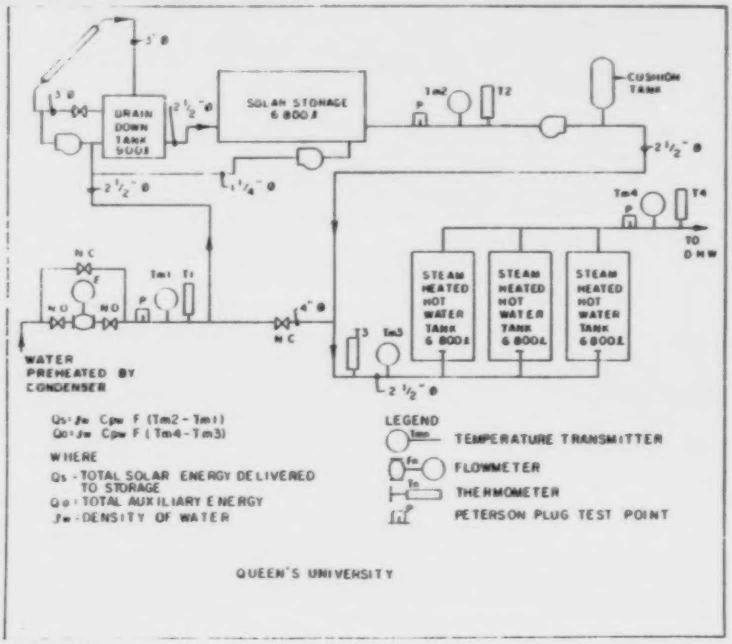
PROJECT NAME: QUEEN'S UNIVERSITY
Kingston, Ontario

CONTACT: T. Yung
TELEPHONE: (613)547-6640

A Canada/Ontario Energy
Demonstration Project

SERVICE: Domestic hot water for gymnasium
OPERATING TEMPERATURES: 10 degrees C inlet; 60 degrees C demand
COMMISSIONING DATE: March 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


3" Ø
3" Ø
DRAIN DOWN TANK 500ℓ
2 1/2" Ø
SOLAR STORAGE 6 800ℓ
Tm2
T2
P
CUSHION TANK
2 1/2" Ø
1 1/4" Ø
2 1/2" Ø
Tm4
T4
TO DHW
N C
F
N O
N O
Tm1
T1
P
4" Ø
N C
T3
Tm3
STEAM HEATED HOT WATER TANK 6 800ℓ
STEAM HEATED HOT WATER TANK 6 800ℓ
STEAM HEATED HOT WATER TANK 6 800ℓ
2 1/2" Ø
WATER PREHEATED BY CONDENSER
Qs: ρw Cpw F (Tm2 - Tm1)
Qa: ρw Cpw F (Tm4 - Tm3)
WHERE
Qs - TOTAL SOLAR ENERGY DELIVERED TO STORAGE
Qa : TOTAL AUXILIARY ENERGY
ρw - DENSITY OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOWMETER
Tn THERMOMETER
P PETERSON PLUG TEST POINT
QUEEN'S UNIVERSITY

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: NORTEC TD1000
Collector Fluid - Water
Number of Collectors - 150 Area - 293 square meters
SOLAR STORAGE: 6800 litres
AUXILIARY HEATERS: 3 - 6800 litres steam heated hot water tanks
HEAT EXCHANGERS:
MONITORING INSTRUMENTS: Flow meter - 2" Kent TM2000
Energy meter - dual channel Rho Sigma energy meter measuring solar energy delivered and auxiliary energy delivered

VARIABLES:
Os - total useful solar heat delivered to the load
Oa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Queen's University
Location: Kingston

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			29.64 (46.08)	16.44 (0.00)	-
SEP-84			6.83 (30.90)	24.07 (0.00)	System shutdown for part of SEP for pump repairs.
OCT-84			17.52 (42.35)	37.48 (12.65)	-
NOV-84			16.26 (23.49)	61.02 (53.79)	-
DEC-84			7.37 (15.75)	69.82 (61.44)	-
JAN-85			11.88 (26.06)	57.25 (43.07)	-
FEB-85			11.36 (33.64)	45.09 (22.81)	-
MAR-85			28.35 (53.52)	77.00 (51.83)	-
APR-85			38.94 (58.75)	112.49 (92.68)	-
MAY-85			47.24 (69.79)	109.24 (86.69)	-
JUN-85			45.57 (71.08)	81.36 (55.85)	-
JUL-85			35.72 (62.54)	36.33 (9.51)	-
Totals			296.68	727.59	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- One collector required replacement of glazing. It was repaired in September.
- The solar heated water is drawn off the bottom of the solar storage tank which will decrease the efficiency of the system.
- The solar circulation pump was replaced in November with a larger capacity pump. This should improve system efficiency.
- The cold water is preheated by a condensor in the ice making room.
- The load at this site ranges between 14 to 31 m3/day depending on the time of the school year.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Queen's University
Location: Kingston

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		20.2	
SEP-84	420		16.0	
OCT-84	279		9.4	
NOV-84	150		3.5	
DEC-84	130		-4.7	
JAN-85	96		-8.2	
FEB-85	252		-6.7	
MAR-85	403		-1.4	
APR-85	510		6.1	
MAY-85	620		12.4	
JUN-85	660		18.0	
JUL-85	682		21.1	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

- No expenditures required as system is on warranty.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 370

REPORT DATE: 85/09/10

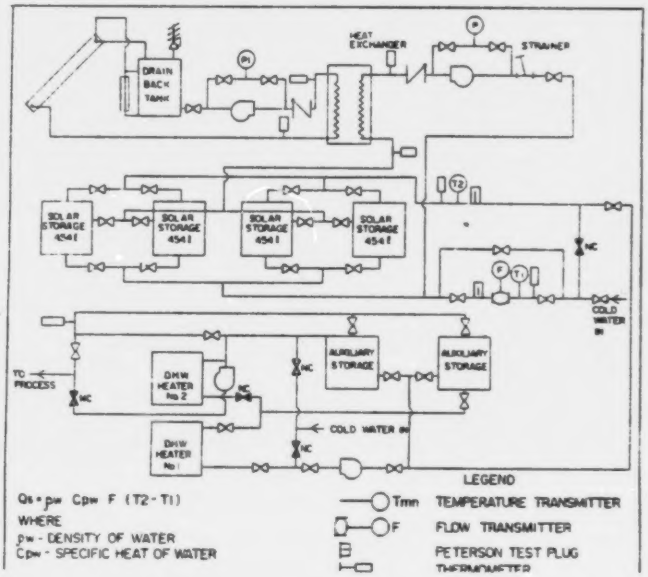
PROJECT NAME: QUICK CLEAN LAUNDROMAT
1284 Prince Road
Windsor, Ontario

CONTACT: Leo Hamel
TELEPHONE: (519) 254-6260

A Canada/Ontario Energy
Demonstration Project

SERVICE: D.H.W. heating for washing machines - 20 machines
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/06/21 REPORTING PERIOD: Aug 84 to July 85 .

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


DRAIN BACK TANK
PI
HEAT EXCHANGER
P
STRAINER
SOLAR STORAGE 454 l
SOLAR STORAGE 454 l
SOLAR STORAGE 454 l
SOLAR STORAGE 454 l
T2
NC
F
T1
COLD WATER IN
TO PROCESS
NC
DHW HEATER No 2
NC
NC
AUXILIARY STORAGE
AUXILIARY STORAGE
COLD WATER IN
NC
DHW HEATER No 1
Qs = ρw Cpw F (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUN-RAY
Collector Fluid - Water
Number of Collectors - 18 Area - 47.7 m2
SOLAR STORAGE: 1816 litres
AUXILIARY HEATERS: Raytherm Gas Fired Heaters
HEAT EXCHANGERS: 1 pass shell & tube
MONITORING INSTRUMENTS: 2 - 24V Elapsed Timers
1 - 1 1/2" Hersey Sunmeter
VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Quick Clean Laundromat
Location: Windsor, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			10.09	75.30	-
			(11.53)	(73.86)	
SEP-84			7.19	75.45	-
			(7.52)	(75.12)	
OCT-84			4.86	94.52	-
			(4.07)	(95.31)	
NOV-84			2.66	107.95	-
			(0.00)	(110.61)	
DEC-84			1.84	73.64	-
			(0.00)	(75.48)	
JAN-85			1.13	48.82	-
			(0.00)	(49.95)	
FEB-85			2.98	174.20	-
			(1.59)	(175.59)	
MAR-85			4.77	300.31	-
			(5.19)	(299.89)	
APR-85			9.36	174.77	-
			(7.73)	(176.40)	
MAY-85			14.10	99.64	-
			(11.26)	(102.48)	
JUN-85			14.45	90.03	-
			(12.96)	(91.52)	
JUL-85			14.05	95.35	-
			(13.57)	(95.83)	
Totals			87.48	1409.98	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned June 21,1984.
- During a site visit 84/12/11 the drain back time was found to be in excess of 8 minutes. This could cause freezing in the piping.
- The owner reports that holes created in the roof by the system contractor during installation of the solar heating system are causing leaks.
- The owner reports that no action has been taken towards the repair of the holes in the roof which were created during installation of the solar heating system as of July 1985.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Quick Clean Laundromat
Location: Windsor, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.3	
SEP-84	420		17.4	
OCT-84	279		11.1	
NOV-84	150		4.4	
DEC-84	130		-1.9	
JAN-85	96		-4.9	
FEB-85	252		-3.8	
MAR-85	403		1.2	
APR-85	510		8.1	
MAY-85	620		14.2	
JUN-85	660		19.7	
JUL-85	682		22.2	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- Approximately $1000.00 was spent on repairs to the roof of the building.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 380

REPORT DATE: 85/09/10 PAGE 1

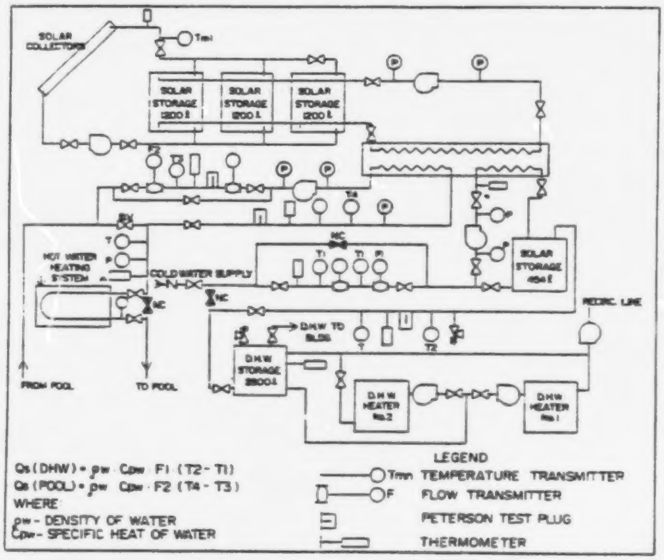
PROJECT NAME: REGENCY RACQUETS CLUB
Bramalea, Ontario

CONTACT: Karen McPherson
TELEPHONE: (416) 792-2232

A Canada/Ontario Energy
Demonstration Project

SERVICE: Pool and DHW Heating
OPERATING TEMPERATURES: DHW 10 degrees Celsius Inlet; 60 degrees Celsius Demand. Pool 27 degrees Celsius Inlet; 29 degrees Celsius Demand
COMMISSIONING DATE:
REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
Tm1
SOLAR STORAGE 1200 ℓ
SOLAR STORAGE 1200 ℓ
SOLAR STORAGE 1200 ℓ
P
P
F2
T3
P
P
T4
P
RV
T
P
HOT WATER HEATING SYSTEM
COLD WATER SUPPLY
NC
NC
NC
T1
T1
P1
SOLAR STORAGE 454 ℓ
RECIRC. LINE
DHW TO BLDG
T
T2
DHW STORAGE 2800 ℓ
DHW HEATER No.2
DHW HEATER No.1
FROM POOL
TO POOL
Qs (DHW) = ρw · Cpw · F1 · (T2 - T1)
Qs (POOL) = ρw · Cpw · F2 (T4 - T3)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETRO-SUN INC.
Collector Fluid - Water
Number of Collectors - 120 Area - 360 m2
SOLAR STORAGE: 3600 litres
AUXILIARY HEATERS: 2 gas fired Hot Water heaters
HEAT EXCHANGERS: Alfa-Laval Model P22-VL
MONITORING INSTRUMENTS: 3 - Ontario Research Foundation Single Channel Energy Meters, 1 - 1" Kent Flowmeter, 1 - 3" Valmet flowmeter, 1 flow simulator, 2 - 110 VAC elapsed timers.

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 380

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Regency Racquets Club
Location: Bramalea, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			52.39	141.96	-
			(88.82)	(105.53)	
SEP-84			63.05	131.98	-
			(61.82)	(133.21)	
OCT-84			12.76	152.00	-
			(36.41)	(128.35)	
NOV-84			6.92	152.52	-
			(4.94)	(154.50)	
DEC-84			4.22	202.39	-
			(0.00)	(206.61)	
JAN-85			2.97	354.93	-
			(0.00)	(357.90)	
FEB-85			9.57	297.60	Pool system shutdown.
			(19.04)	(288.13)	
MAR-85			11.51	240.20	-
			(46.31)	(205.40)	
APR-85			27.57	186.71	-
			(62.57)	(151.71)	
MAY-85			62.41	193.67	Pool system is now operational.
			(88.86)	(167.22)	
JUN-85			12.43	150.53	-
			(93.21)	(69.75)	
JUL-85			12.84	155.54	-
			(97.32)	(71.06)	
Totals			278.64	2360.03	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment was installed and commissioned May 22, 1984.
- The collectors are partially shadowed by an adjacent building during the winter months. Snow tends to build up on the collectors as they are at a slope of 30 degrees.
- A site visit 85/02/15 found that the heat exchanger has developed a slight leak.
- A site visit has revealed that this system exhibits control problems. The solar collection time is low and as a result the energy produced is lower than expected for June and July. (Aug. 1985)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Regency Racquets Club
Location: Bramalea, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.9	
SEP-84	420		14.8	
OCT-84	279		8.8	
NOV-84	150		2.8	
DEC-84	130		-4.1	
JAN-85	96		-7.3	
FEB-85	252		-6.6	
MAR-85	403		-1.5	
APR-85	510		5.8	
MAY-85	620		11.6	
JUN-85	660		16.9	
JUL-85	682		19.8	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs
during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 145

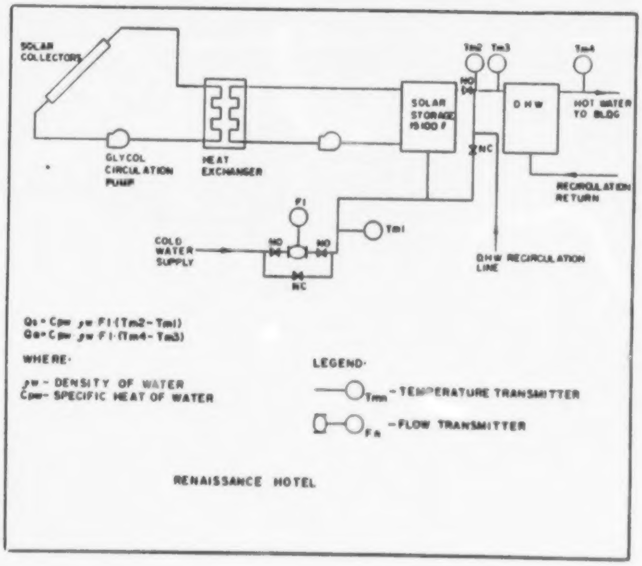
REPORT DATE: 85/09/10

PROJECT NAME: RENAISSANCE HOTEL
Scarborough, Ontario

CONTACT: Murray Blakie
TELEPHONE: (416)299-1500

SERVICE: Domestic hot water
OPERATING TEMPERATURES: 5 degrees C inlet, 60 degrees C demand
COMMISSIONING DATE: Feb 1983
REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
GLYCOL CIRCULATION PUMP
HEAT EXCHANGER
SOLAR STORAGE 15100 ℓ
Tm2
Tm3
Tm4
NO
NC
DHW
HOT WATER TO BLDG
RECIRCULATION RETURN
F1
Tm1
COLD WATER SUPPLY
NO
NO
NC
DHW RECIRCULATION LINE
Qs = Cpw ρw F1 (Tm2 - Tm1)
Qa = Cpw ρw F1 (Tm4 - Tm3)
WHERE:
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND:
Tmn - TEMPERATURE TRANSMITTER
Fn - FLOW TRANSMITTER
RENAISSANCE HOTEL

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLATHERM
Collector Fluid - 50% glycol/water
Number of Collectors - 122 Area - 288 square meters
SOLAR STORAGE: 15,100 litres
AUXILIARY HEATERS:
HEAT EXCHANGER: Alfa Laval P22VL
MONITORING INSTRUMENTS: Flow meter - 3" Neptune Trident cold water meter
Energy Meter - Ontario Research Foundation Dual Channel
VARIABLES:
Qs - total useful heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Renaissance Hotel
Location: Scarborough

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			97.41	378.99	-
			(66.70)	(409.70)	
SEP-84			53.07	265.62	-
			(52.27)	(266.42)	
OCT-84			72.58	420.85	-
			(41.94)	(451.49)	
NOV-84			58.10	437.20	-
			(11.89)	(483.41)	
DEC-84			59.08	460.24	-
			(2.08)	(517.24)	
JAN-85			43.71	475.62	-
			(12.98)	(506.35)	
FEB-85			48.53	474.76	-
			(26.69)	(496.60)	
MAR-85			14.00	367.84	System shutdown for part of MAR for modifications.
			(42.00)	(339.84)	
APR-85			42.59	251.12	-
			(44.64)	(249.07)	
MAY-85			26.61	127.04	-
			(52.55)	(101.10)	
JUN-85			46.13	139.46	-
			(59.20)	(126.39)	
JUL-85			127.63	358.85	-
			(68.59)	(417.89)	
Totals			689.44	4157.59	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The glycol circulation pump was repaired and 340 litres of glycol were added in mid December.
- The site contact reports that the problem with collector coupling leaks has not been solved.
- Between 1983 and March 1985 a hot water recirculation line dumped into the solar storage tank, this caused a reduction in system efficiency. This unmonitored heat gain tended to artificially inflate the solar energy readings.
- The solar heating system was shutdown for part of March 1985 to allow for modifications. The recirculation line was relocated to improve solar efficiency.
- During a recent windstorm some of the flashing between the collectors was damaged. (June/85)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Renaissance Hotel
Location: Scarborough

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures required as system is on warranty.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 153

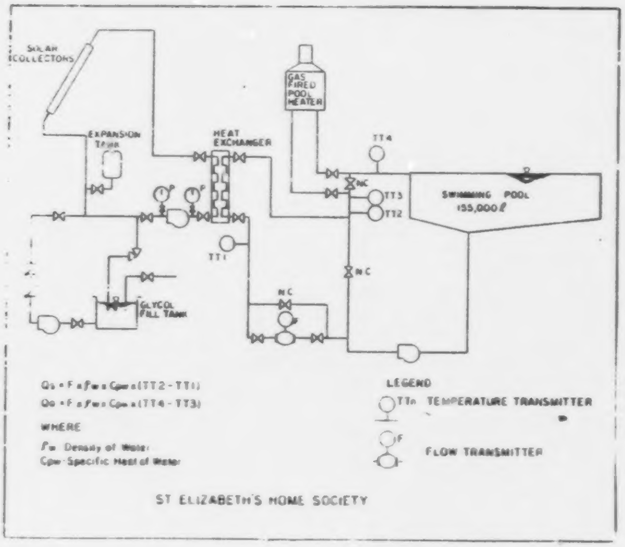
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: ST. ELIZABETH HOME SOCIETY
393 Rymal Rd., Hamilton, Ont.

CONTACT: Omar Elwedini
Louise Gaspar
TELEPHONE: (416)389-3893

SERVICE: Swimming Pool
OPERATING TEMPERATURES: 27 Degrees C Inlet; 30 Degrees C Demand
COMMISSIONING DATE: 83/05/01 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
EXPANSION TANK
HEAT EXCHANGER
GAS FIRED POOL HEATER
TT4
NC
TT3
TT2
SWIMMING POOL 155,000 ℓ
TT1
NC
NC
GLYCOL FILL TANK
Qs = F x ρw x Cpw x (TT2 - TT1)
Qa = F x ρw x Cpw x (TT4 - TT3)
WHERE
ρw Density of Water
Cpw Specific Heat of Water
LEGEND
TTn TEMPERATURE TRANSMITTER
F
FLOW TRANSMITTER
ST ELIZABETH'S HOME SOCIETY

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUN RAY SOLAR SYSTEMS LTD.
Collector Fluid - 50% propylene glycol, 50% water
Number of Collectors - 35 Area - 65.8 square meters
SOLAR STORAGE: 155,000 litres (pool storage)
AUXILIARY HEATERS: gas fired pool heater, 398,000 BTU/hr
HEAT EXCHANGERS: American Standard, type BCF
MONITORING INSTRUMENTS: - ORF Dual Channel Energy Meter
- 2" Neptune, Trident, style #3, flow meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: St. Elizabeth Home Society
Location: 393 Rymal Road, Hamilton

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			17.71 (16.44)	14.39 (15.66)	-
SEP-84			9.47 (12.87)	13.31 (9.91)	-
OCT-84			2.12 (5.78)	4.26 (0.60)	-
NOV-84					Data unavailable due to flow meter failure.
DEC-84			0.90 (2.60)	21.36 (19.66)	Flow meter was repaired 84/12/06.
JAN-85			0.82 (5.44)	26.79 (22.17)	-
FEB-85			2.16 (8.30)	22.77 (16.63)	-
MAR-85					Data unavailable due to flow meter failure.
APR-85					Data unavailable due to flowmeter failure.
MAY-85					Data unavailable due to flow meter failure.
JUN-85			21.30 (16.63)	24.13 (28.80)	-
JUL-85			24.40 (18.10)	27.77 (34.07)	-
Totals			78.88	154.78	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- System installed by previous monitoring contractor was repaired by installing the correct flowmeter pulse head and calibrating the energy meter. Monitoring system was commissioned Nov 29,1983.

- This solar heating system is not equipped with a check valve to prevent thermosyphoning or freezestats for backup freeze protection.

- The flow meter has been repaired by the monitoring contractor 84/12/06.

- A representative of Neptune Meters visited this site and repaired the flow meter. (85/06/03)

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: St. Elizabeth Home Society
Location: 393 Rymal Road, Hamilton

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		20.0	
SEP-84	420		15.7	
OCT-84	279		9.4	
NOV-84	150		3.5	
DEC-84	130		-3.4	
JAN-85	96		-6.4	
FEB-85	252		-6.3	
MAR-85	403		-0.8	
APR-85	510		6.1	
MAY-85	620		12.6	
JUN-85	660		18.0	
JUL-85	682		20.5	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- No expenditures were required on the solar heating system.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 390

REPORT DATE: 85/09/10

PAGE 1

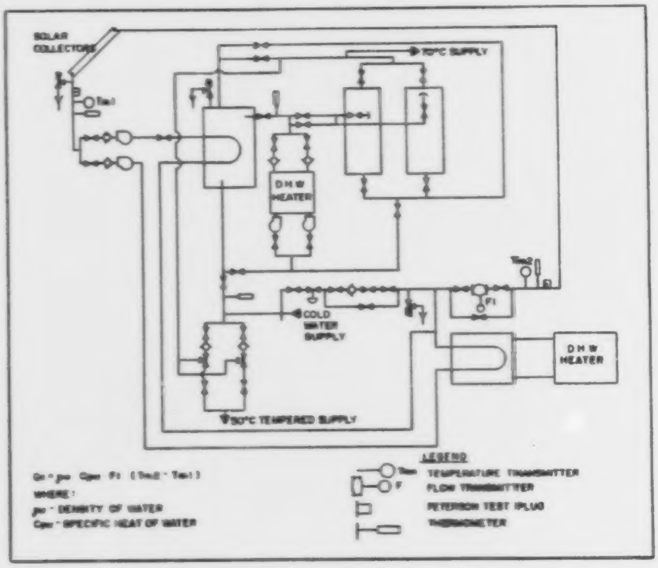
PROJECT NAME: ST. ELIZABETH HOME SOCIETY
393 Rymal Road, Hamilton, Ont.

A Canada/Ontario Energy
Demonstration Project

CONTACT: Omar Elwedini
Louise Gaspar
TELEPHONE: (416) 389-3893

SERVICE: Domestic Hot Water Heating
OPERATING TEMPERATURES: 8 Degrees C Inlet; 50 Degrees C Demand
COMMISSIONING DATE: 85/05/31 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416) 965-3003


SOLAR COLLECTORS
Tm1
70°C SUPPLY
DHW HEATER
Tm2
F1
COLD WATER SUPPLY
DHW HEATER
50°C TEMPERED SUPPLY
Qs = ρw Cpw F1 (Tm2 - Tm1)
WHERE:
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUN-RAY - SRS-48BC
Collector Fluid - WATER
Number of Collectors - 106 Area - 315 m2
SOLAR STORAGE: 5700 litres
AUXILIARY HEATERS: Two Rudd Gas Fired Heater
HEAT EXCHANGERS: Tube in shell
MONITORING INSTRUMENTS: Hersey Sunmeter, 3" Hersey Flow meter,
2 - Simpson elapsed timers

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 390

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: St. Elizabeth Home Society
Location: Hamilton, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85					-
JUN-85					-
JUL-85					-
Totals					

Units: Gigajoules.

Comments on System Performance:

- The monitoring equipment was commissioned in JUL/85.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: St. Elizabeth Home Society
Location: Hamilton, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		20.0	
SEP-84	420		15.7	
OCT-84	279		9.4	
NOV-84	150		3.5	
DEC-84	130		-3.4	
JAN-85	96		-6.4	
FEB-85	252		-6.3	
MAR-85	403		-0.8	
APR-85	510		6.1	
MAY-85	620		12.6	
JUN-85	660		18.0	
JUL-85	682		20.5	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 156

REPORT DATE: 85/09/10 PAGE 1

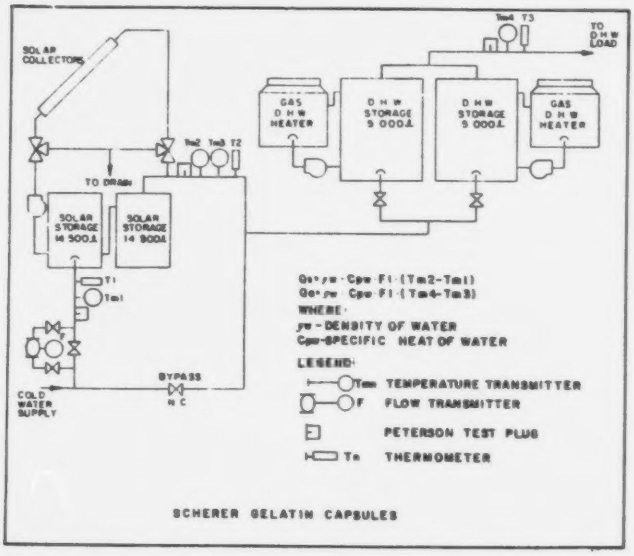
PROJECT NAME: R.P. SCHERER HARDCAPSULE
Windsor, Ontario

CONTACT: Philip Maruncic
Bela Lorincz
TELEPHONE:(519) 969-7841

SERVICE: Process Hot Water
OPERATING TEMPERATURES: 7.5 Degrees C Inlet; 82 Degrees C Demand

COMMISSIONING DATE: Sept. 1, 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
TO DRAIN
SOLAR STORAGE 14 500 L
SOLAR STORAGE 14 500 L
Tm2 Tm3 T2
T1
Tm1
F
COLD WATER SUPPLY
BYPASS N C
GAS D H W HEATER
D H W STORAGE 5 000 L
D H W STORAGE 5 000 L
GAS D H W HEATER
Tm4 T3
TO D H W LOAD
Qs=ρw·Cpw·Fl·(Tm2-Tm1)
Qa=ρw·Cpw·Fl·(Tm4-Tm3)
WHERE:
ρw - DENSITY OF WATER
Cpw-SPECIFIC HEAT OF WATER
LEGEND:
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
Tn THERMOMETER

SCHERER GELATIN CAPSULES

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SUNRAY
Collector Fluid - Water
Number of Collectors - 288 Area - 495 square meters
SOLAR STORAGE: 29,000 litres
AUXILIARY HEATERS: Gas fired
HEAT EXCHANGERS: None
MONITORING INSTRUMENTS: Flow meter - 1.5" Neptune Trident
Energy meter - ORF Dual channel energy meter

VARIABLES:
Os - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: R.P. Scherer Hardcapsule
Location: Windsor

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			90.61	89.51	-
			(116.72)	(63.40)	
SEP-84			73.59	159.32	-
			(101.78)	(131.13)	
OCT-84			55.34	237.99	-
			(83.31)	(210.02)	
NOV-84			45.72	224.61	-
			(29.20)	(241.13)	
DEC-84			23.13	231.44	-
			(13.24)	(241.33)	
JAN-85			6.66	297.95	-
			(33.20)	(271.41)	
FEB-85			9.83	273.86	-
			(58.44)	(225.25)	
MAR-85			66.09	258.30	-
			(89.86)	(234.53)	
APR-85			109.28	146.92	-
			(94.03)	(162.17)	
MAY-85			120.05	143.54	-
			(117.03)	(146.56)	
JUN-85			110.64	134.88	-
			(124.97)	(120.55)	
JUL-85			46.96	36.53	Plant shutdown 850715 to 850806.
			(83.07)	(0.42)	
Totals			757.90	2234.85	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- Site was visited July 19,1983 and the monitoring equipment installed by the previous monitoring contractor was repaired and calibrated.
- Collector coupling leaks are present, in addition the pipe hangers are rusting.
- The solar heating system was put back into operation on Feb.15/84 .
- The damaged collector panels have been repaired, and the installation has been installed. This system still exhibits some control problems.
- A plant shutdown in July resulted in reduced load and performance.
- The owner has decided not to operate this system during freezing weather.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: R.P. Scherer Hardcapsule
Location: Windsor

Weather Data for the Site (for previous 12 months)

Month	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2 Historical Mean	Measured	Monthly Mean Ambient Temperature C Historical Mean	Measured
AUG-84	589		21.3	
SEP-84	420		17.4	
OCT-84	279		11.1	
NOV-84	150		4.4	
DEC-84	130		-1.9	
JAN-85	96		-7.1	
FEB-85	252		-4.9	
MAR-85	403		1.2	
APR-85	510		8.1	
MAY-85	620		14.2	
JUN-85	660		19.7	
JUL-85	682		22.2	

Training and Recent Activity of Site Personnel:

- Dennis Chartier attended a M.O.E. Solar Operator's Seminar on March 15,1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 330

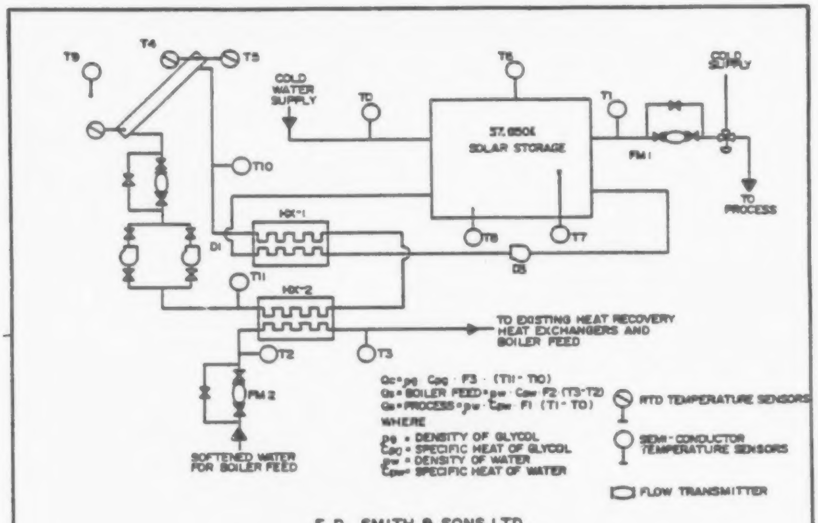
REPORT DATE: 85/09/10 PAGE 1

PROJECT NAME: E.D. SMITH & SONS LTD. CONTACT: Mr. Gamache
Winona, Ontario TELEPHONE: (416) 643-1211

A Canada/Ontario Energy
Demonstration Project

SERVICE: Heating of Process Water and Boiler Feed
OPERATING TEMPERATURES: 14 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/08/10 REPORTING PERIOD: Aug 83 to July 84

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


T9
T4
T5
T6
COLD WATER SUPPLY
T0
37,850ℓ SOLAR STORAGE
T1
COLD SUPPLY
FM1
TO PROCESS
T10
HX-1
D1
T8
T7
D5
T11
HX-2
TO EXISTING HEAT RECOVERY HEAT EXCHANGERS AND BOILER FEED
T2
T3
FM2
SOFTENED WATER FOR BOILER FEED
Qc = ρg · Cpg · F3 · (T11 - T10)
Qs = BOILER FEED = ρw · Cpw · F2 (T3 - T2)
Qs = PROCESS = ρw · Cpw · F1 (T1 - T0)
WHERE
ρg = DENSITY OF GLYCOL
Cpg = SPECIFIC HEAT OF GLYCOL
ρw = DENSITY OF WATER
Cpw = SPECIFIC HEAT OF WATER
RTD TEMPERATURE SENSORS
SEMI-CONDUCTOR TEMPERATURE SENSORS
FLOW TRANSMITTER

E.D. SMITH & SONS LTD.
SOLAR HEATING SYSTEM

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: GENERAL SOLAR
Collector Fluid - 30/70 Propylene glycol/water
Number of Collectors - 18 Area - 846 m2
SOLAR STORAGE: 37,850 litres
AUXILIARY HEATERS: Steam heat
HEAT EXCHANGERS: Hx-1 Alfa Laval P2-VL 11.88 m2 Hx-2 Alfa Laval P2-VL 5.88 m2
MONITORING INSTRUMENTS: Micro processor based data acquisition and communication system supplied by Admic Controls Ltd.
ORF - single channel, 3" Cosmos Flowmeter
4" Cosmos Flowmeter
2" Valmet Flowmeter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: E. D. Smith & Sons Ltd.
Location: Winona, Ontario
Application: Process Water

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84					-
SEP-84					-
OCT-84			30.66	377400	-
NOV-84			56.98	1129600	-
DEC-84			21.45	738200	-
JAN-85			41.30	822200	Monitoring equipment failed 85/01/24.
FEB-85		24.27			-
MAR-85			122.51	996600	-
APR-85			125.03	1038200	-
MAY-85			164.35	1363900	-
JUN-85			157.23	1750100	-
JUL/85			111.36	1968100	-
Totals		24.27	830.87	10184300	

Units: Energy = Gigajoules, Water Usage = litres

Comments on System Performance:

- This site is being monitored with a micro processor based data acquisition and communication system supplied by Admic Controls Ltd.
- The monitoring equipment was commissioned October 19, 1984.
- A control sensor failure caused a dump valve to remain open for two weeks in December. This caused a reduction in system efficiency.
- The remote data acquisition system failed 85/01/24, as a result the energy data for JAN represents twenty-three days of operation. The remote monitoring equipment was repaired in February. The solar heating system was operating during the period when the monitoring equipment was being repaired.
- The Qs data for FEB is unavailable due to an equipment failure. The Qc data for FEB was obtained from the energy meter measuring energy collected on the glycol side of the heat exchanger, and was apportioned by a statistical analysis of past data.

Site number: 330

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: E. D. Smith & Sons Ltd.
Location: Winona, Ontario
Application: Boiler Feed Water

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84					-
SEP-84					-
OCT-84			11.88	273300	-
DEC-84			11.24	683400	-
NOV-84			27.05	873600	-
JAN-85			13.47	630900	Monitoring equipment failed 85/01/24.
FEB-85		19.29			-
MAR-85			37.17	770200	-
APR-85			66.62	883800	-
MAY-85			60.87	997000	-
JUN-85			52.74	1067200	-
JUL-85			56.13	806800	-
Totals		19.29	337.17	6986200	

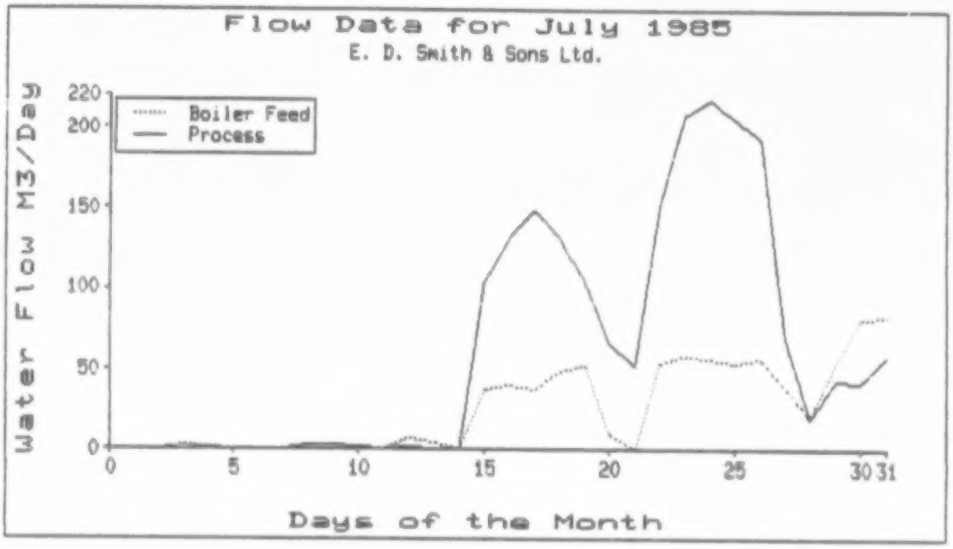
Units: Energy = Gigajoules, Water Usage = litres

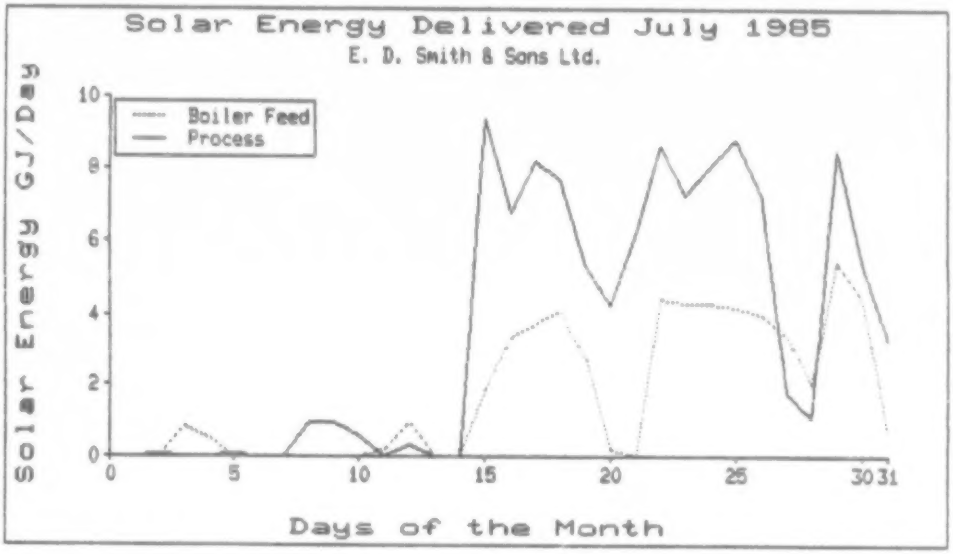
Comments on System Performance:

- This site is being monitored with a micro processor based data acquisition and communication system supplied by Admic Controls Ltd.
- The monitoring equipment was commissioned October 19, 1984.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: E. D. Smith & Sons Ltd.
Location: Winona, Ontario





Site number: 330

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: E. D. Smith & Sons Ltd.
Location: Winona, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.4	
SEP-84	420		17.3	
OCT-84	279		11.2	
NOV-84	150		5.1	
DEC-84	130		-1.1	
JAN-85	96		-4.2	
FEB-85	252		-3.7	
MAR-85	403		0.8	
APR-85	510		7.3	
MAY-85	620		13.2	
JUN-85	660		19.1	
JUL-85	682		22.1	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 395

REPORT DATE: 85/09/10 PAGE 1

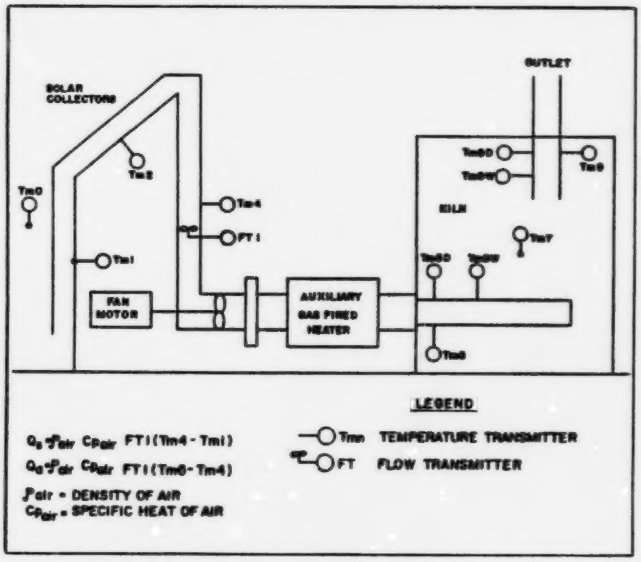
PROJECT NAME: TRENT TIMBER TREATING INC.
Peterborough, Ontario

A Canada/Ontario Energy
Demonstration Project

CONTACT: Norris McCauley
Randy Kingdon
TELEPHONE: (705) 745-3223

SERVICE: Preheating of Kiln Air
OPERATING TEMPERATURES: Ambient Inlet; 26 Degrees C Demand
COMMISSIONING DATE: 85/03/19 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416) 965-3003


SOLAR COLLECTORS
Tm0
Tm2
Tm1
Tm4
FT1
FAN MOTOR
AUXILIARY GAS FIRED HEATER
OUTLET
Tm8D
Tm8W
Tm9
KILN
Tm7
Tm5D
Tm5W
Tm6
LEGEND
$Q_s = \rho_{air}\ Cp_{air}\ FT1(Tm4 - Tm1)$
$Q_a = \rho_{air}\ Cp_{air}\ FT1(Tm6 - Tm4)$
ρ_{air} = DENSITY OF AIR
Cp_{air} = SPECIFIC HEAT OF AIR
Tmn TEMPERATURE TRANSMITTER
FT FLOW TRANSMITTER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: CONSERVAL
Collector Fluid - Air
Number of Collectors - Site Built Area - 222 m2
SOLAR STORAGE: None
AUXILIARY HEATERS: Gas Fired Heaters
HEAT EXCHANGERS: None
MONITORING INSTRUMENTS: Admic Controls Ltd., Remote Data Acquisition System, Ontario Research Foundation, Anemometer & Scaling Board

VARIABLES:
Os - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

Site number: 395

Report Date: JUL/85

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Trent Timber Treating Inc.
Location: Peterborough, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84					-
SEP-84					-
OCT-84					-
NOV-84					-
DEC-84					-
JAN-85					-
FEB-85					-
MAR-85					-
APR-85					-
MAY-85			6.55	46.53	-
JUN-85			3.94	0.00	-
JUL-85			5.24	0.00	-
Totals			15.73	46.53	

Units: Gigajoules.

Comments on System Performance:

- The solar heating system preheats the air entering a kiln and as a result only operates when the kiln is operating.
- The operation of the kiln during the summer months has been minimal.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Trent Timber Treating Inc.
Location: Peterborough, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		18.8	
SEP-84	420		14.6	
OCT-84	279		9.1	
NOV-84	150		2.4	
DEC-84	130		-5.5	
JAN-85	96		-8.6	
FEB-85	252		-7.1	
MAR-85	403		-2.0	
APR-85	510		6.2	
MAY-85	620		12.0	
JUN-85	660		17.6	
JUL-85	682		20.7	

Training and Recent Activity of Site Personnel:

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 356

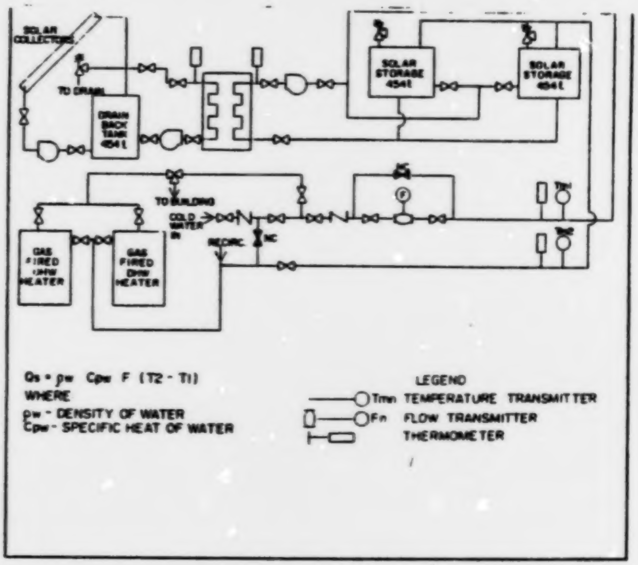
REPORT DATE: 85/09/10

PROJECT NAME: TRILLIUM RESTAURANT
Ontario Place
Toronto, Ontario

CONTACT: Harry Chupa
TELEPHONE: (416) 965-4873

SERVICE: DHW Heating
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: 84/08/15
REPORTING PERIOD: Aug 83 to July 84

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
TO DRAIN
DRAIN BACK TANK 454 L
SOLAR STORAGE 454 L
SOLAR STORAGE 454 L
TO BUILDING
COLD WATER IN
RECIRC.
NC
F
T1
T2
GAS FIRED DHW HEATER
GAS FIRED DHW HEATER
Qs = ρw Cpw F (T2 - T1)
WHERE
ρw - DENSITY OF WATER
Cpw - SPECIFIC HEAT OF WATER
LEGEND
Tmn TEMPERATURE TRANSMITTER
Fn FLOW TRANSMITTER
THERMOMETER

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: PETRO SUN
Collector Fluid - Water
Number of Collectors - 10 Area - 29.78 m2
SOLAR STORAGE: 908 litres
AUXILIARY HEATERS: 2 - Rheem-glass gas fired hot water heaters
HEAT EXCHANGERS: NIXON V-4SST
MONITORING INSTRUMENTS: Rho Sigma Single Channel Energy Meter
2 inch Kent TM 200-2 Flowmeter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Trillium Restaurant
Location: Toronto, Ontario

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Water Usage	Remarks
AUG-84					-
SEP-84			2.28	58751	-
OCT-84			0.91	37811	-
NOV-84			0.42	38812	-
DEC-84			0.27	40514	-
JAN-85			0.04	4286	-
FEB-85			0.01	2705	-
MAR-85			0.07	3531	-
APR-85			0.03	46358	-
MAY-85					Data unavailable as system is shutdown for repairs.
JUN-85					System shutdown.
JUL-85					System shutdown.
Totals			4.03	232768	

Units: Energy = Gigajoules, Water Usage = litres

Comments on System Performance:

- The monitoring equipment was installed and commissioned 84/08/15. Auxiliary energy is not measured at this site.
- The load at this site is very low during the winter months, adversely affecting efficiency.
- Circulation pump P2 is running hot. The site contact has notified the system contractor, however no action has been taken as of 85/01/28.
- Site contact reports that circulation pump P1 has failed. The system contractor has been notified, however no repairs have been made to pumps P1 or P2 as of 85/04/15.
- The pumps were repaired in May 1985.
- The solar heating system is presently shutdown due to pump motor control problems. The system will remain shutdown until the deficiencies are corrected by the system contractor.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: Trillium Restaurant
Location: Toronto, Ontario

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.1	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

- Harry Chupa attended a Solar Operator's Seminar Oct. 16, 1984.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT
SITE NUMBER 225

REPORT DATE: 85/09/10 PAGE 1

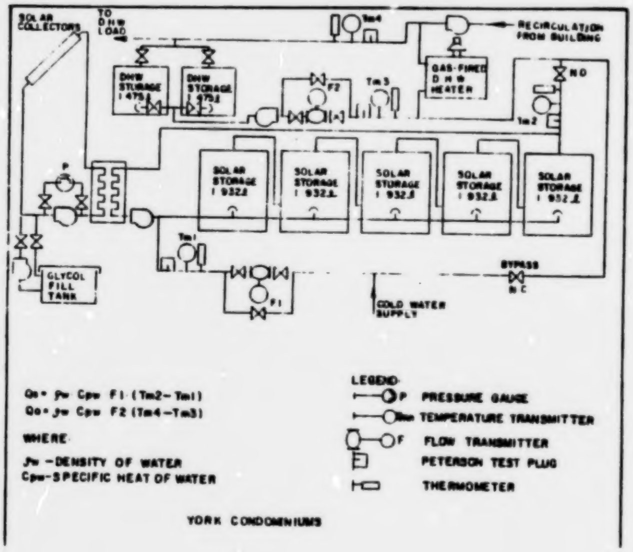
PROJECT NAME: YORK CONDOMINIUM 340
Rexdale, Ontario

CONTACT: Joe Schnezler
TELEPHONE: (416)662-1570

A Canada/Ontario Energy
Demonstration Project

SERVICE: DHW
OPERATING TEMPERATURES: 10 Degrees C Inlet; 60 Degrees C Demand
COMMISSIONING DATE: July 1, 1983 REPORTING PERIOD: Aug 84 to July 85

Ministry of
Energy contact:
Tom Markowitz
(416)965-3003


SOLAR COLLECTORS
TO DHW LOAD
Tm4
RECIRCULATION FROM BUILDING
DHW STORAGE 1 475 ℓ
DHW STORAGE 1 475 ℓ
F2
Tm3
GAS-FIRED DHW HEATER
NO
Tm2
P
SOLAR STORAGE 1 932 ℓ
SOLAR STORAGE 1 932 ℓ
SOLAR STORAGE 1 932 ℓ
SOLAR STORAGE 1 932 ℓ
SOLAR STORAGE 1 932 ℓ
Tm1
GLYCOL FILL TANK
F1
BYPASS
NC
COLD WATER SUPPLY
Qs = ρw Cpw F1 (Tm2 − Tm1)
Qa = ρw Cpw F2 (Tm4 − Tm3)
WHERE
ρw − DENSITY OF WATER
Cpw − SPECIFIC HEAT OF WATER
LEGEND
P PRESSURE GAUGE
Tm TEMPERATURE TRANSMITTER
F FLOW TRANSMITTER
PETERSON TEST PLUG
THERMOMETER
YORK CONDOMINIUMS

SYSTEM DESCRIPTION:

SOLAR COLLECTORS: Manufacturer: SOLARTHERM
Collector Fluid - 50% propylene glycol/50% water
Number of Collectors - 104 Area - 310 square meters
SOLAR STORAGE: 9,600 litres
AUXILIARY HEATERS: two gas fired DHW heaters, 750,000 BTU/hr
HEAT EXCHANGERS: Alfa Laval P22HBL

MONITORING INSTRUMENTS: Flow meters - Kent TM200 - 2"
- Kent TM230 - 2"
Energy Meter - Rho Sigma RS 315 FP, dual energy meter

VARIABLES:
Qs - total useful solar heat delivered to the load
Qa - total useful heat delivered to the same load by auxiliary heat source

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: York Condominium 340
Location: Islington

Measured/(Predicted) Performance

Month	Q(i)	Q(c)	Q(s)	Q(a)	Remarks
AUG-84			4.53	0.79	-
			(5.32)	(0.00)	
SEP-84			6.87	0.46	Flow meter problems
			(7.33)	(0.00)	are affecting data.
OCT-84			0.00	107.51	Solar data unavailable due
			(37.74)	(69.77)	to flow meter failure.
NOV-84			0.00	312.34	-
			(9.99)	(302.35)	
DEC-84			17.24	789.34	-
			(0.00)	(806.58)	
JAN-85			12.74	793.85	-
			(10.49)	(796.10)	
FEB-85			29.34	571.44	-
			(25.23)	(575.55)	
MAR-85			72.72	503.16	-
			(42.04)	(533.84)	
APR-85			66.04	931.72	-
			(45.90)	(951.86)	
MAY-85			42.92	888.00	-
			(59.58)	(871.34)	
JUN-85					Data unavailable due to flow meter failures.
JUL-85					-
Totals			252.40	4898.61	

Units: Gigajoules. Predicted performance is based on the "F Chart" model, using real load data, and historical average weather data.

Comments on System Performance:

- The monitoring equipment has been repaired.
- The solar flow meter failed due to internal corrosion. It was repaired 84/11/30.
- An additional gas-fired D.H.W. heater has been added to this system. The monitoring equipment has been modified to accomodate this change.
- The circulation line between the DHW storage and the DHW heaters has been insulated.
- The solar flow meter pulser failed. The auxiliary flow meter failed as a result of internal corrosion. The solar flow meter pulser was repaired 85/08/28. The auxiliary flow meter requires replacement.

ONTARIO MINISTRY OF ENERGY
MONTHLY SOLAR MONITORING REPORT

Site: York Condominium 340
Location: Islington

Weather Data for the Site (for previous 12 months)

	Total Monthly Solar Radiation on a Horizontal Surface MJ/m2		Monthly Mean Ambient Temperature C	
Month	Historical Mean	Measured	Historical Mean	Measured
AUG-84	589		21.2	
SEP-84	420		17.0	
OCT-84	279		11.0	
NOV-84	150		4.9	
DEC-84	130		-1.6	
JAN-85	96		-4.6	
FEB-85	252		-3.9	
MAR-85	403		0.7	
APR-85	510		7.6	
MAY-85	620		13.6	
JUN-85	660		19.1	
JUL-85	682		22.0	

Training and Recent Activity of Site Personnel:

- Joe Schnezler attended an M.O.E. seminar for Solar Heating Operators on Oct 13,1983.

Solar Heating System Maintenance and Repair Costs during Previous 12 Months:

- The solar heating system maintenance is carried out under a preventative maintenance contract at a cost of $156.00 per month.

APPENDIX I

The following weather data are applicable for the following sites: 114, 137, 140, 145, 203, 205, 210, 350, 355, 356

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	169	-6.6
FEB-84	222	0.5
MAR-84	398	-2.6
APR-84	503	8.2
MAY-84	520	11.7
JUN-84	729	19.7
JUL-84	651	21.2
AUG-84	561	22.3
SEP-84	402	15.6
OCT-84	261	12.0
NOV-84	159	4.8
DEC-84	105	1.7

The following weather data are applicable for the following sites: 142, 225, 305, 314, 380

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	195	-6.6
FEB-84	241	0.5
MAR-84	447	-2.6
APR-84	485	8.2
MAY-84	534	11.7
JUN-84	763	19.7
JUL-84	660	21.2
AUG-84	577	22.3
SEP-84	395	15.6
OCT-84	278	12.0
NOV-84	152	4.8
DEC-84	106	1.7

The following weather data are applicable for the following sites: 156, 213, 320, 370

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	231	-7.4
FEB-84	267	0.5
MAR-84	431	-2.0
APR-84	529	8.3
MAY-84	598	12.4
JUN-84	757	21.3
JUL-84	709	21.8
AUG-84	619	22.4
SEP-84	421	16.3
OCT-84	289	13.0
NOV-84	210	3.9
DEC-84	142	1.2

The following weather data are applicable for the following sites: 139, 153, 220, 390

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	204	-7.2
FEB-84	230	-0.2
MAR-84	406	--
APR-84	--	7.0
MAY-84	528	11.4
JUN-84	761	19.5
JUL-84	683	20.7
AUG-84	565	21.4
SEP-84	379	15.1
OCT-84	262	11.2
NOV-84	179	3.7
DEC-84	399	0.9

The following weather data are applicable for the following sites: 117, 204, 330

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	204	-6.0
FEB-84	230	0.4
MAR-84	406	-3.0
APR-84	--	7.5
MAY-84	528	11.0
JUN-84	761	19.6
JUL-84	683	21.0
AUG-84	565	22.0
SEP-84	379	15.4
OCT-84	262	11.3
NOV-84	179	4.6
DEC-84	399	1.0

The following weather data are applicable for the following sites: 227, 312, 360

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	163	-12.7
FEB-84	220	--
MAR-84	453	-6.8
APR-84	445	--
MAY-84	523	10.9
JUN-84	687	--
JUL-84	620	--
AUG-84	533	20.8
SEP-84	439	13.6
OCT-84	294	9.4
NOV-84	170	1.6
DEC-84	118	-4.8

The following weather data are applicable for the following sites: 216, 316A, 316B

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	160	-9.8
FEB-84	235	-2.2
MAR-84	490	-5.9
APR-84	558	6.2
MAY-84	589	8.6
JUN-84	702	15.9
JUL-84	739	18.4
AUG-84	555	20.6
SEP-84	409	13.7
OCT-84	280	10.3
NOV-84	130	3.5
DEC-84	93	-0.7

The following weather data are applicable for the following sites: 206, 313, 340

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	186	-9.0
FEB-84	225	-1.3
MAR-84	491	-4.6
APR-84	530	7.6
MAY-84	555	10.1
JUN-84	686	18.7
JUL-84	687	19.6
AUG-84	547	20.7
SEP-84	413	14.3
OCT-84	304	11.0
NOV-84	150	3.4
DEC-84	99	0.1

The following weather data are applicable for the following sites: 125, 310

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	204	-10.4
FEB-84	230	-2.2
MAR-84	406	-5.3
APR-84	--	6.6
MAY-84	528	9.8
JUN-84	761	17.8
JUL-84	683	18.8
AUG-84	565	19.7
SEP-84	379	12.8
OCT-84	262	9.8
NOV-84	179	2.1
DEC-84	399	-1.1

The following weather data are applicable for the following sites: 147A, 147B

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	186	-19.0
FEB-84	211	-7.3
MAR-84	469	-9.5
APR-84	604	6.4
MAY-84	639	--
JUN-84	551	15.3
JUL-84	687	17.3
AUG-84	569	19.0
SEP-84	372	9.1
OCT-84	201	6.8
NOV-84	163	-3.7
DEC-84	148	-14.6

The following weather data are applicable for the following sites: 344

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	231	-9.5
FEB-84	267	-1.4
MAR-84	431	-4.3
APR-84	529	7.5
MAY-84	598	10.5
JUN-84	757	19.1
JUL-84	709	19.6
AUG-84	619	20.5
SEP-84	421	14.2
OCT-84	289	11.3
NOV-84	210	3.4
DEC-84	142	-0.7

The following weather data are applicable for the following sites: 342

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	231	-8.4
FEB-84	267	-0.3
MAR-84	431	-3.0
APR-84	529	7.0
MAY-84	598	10.8
JUN-84	757	--
JUL-84	709	20.4
AUG-84	619	21.2
SEP-84	421	15.1
OCT-84	239	11.8
NOV-84	210	4.1
DEC-84	142	0.1

The following weather data are applicable for the following sites: 221

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	187	-9.9
FEB-84	--	-2.1
MAR-84	--	-5.8
APR-84	500	7.5
MAY-84	599	9.5
JUN-84	786	17.2
JUL-84	723	19.9
AUG-84	586	20.5
SEP-84	461	14.0
OCT-84	311	10.3
NOV-34	190	3.2
DEC-84	124	-0.8

The following weather data are applicable for the following sites: 222

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	203	-9.5
FEB-84	238	-3.1
MAR-84	489	-5.5
APR-84	503	6.9
MAY-84	702	10.3
JUN-84	789	18.1
JUL-84	709	18.6
AUG-84	602	20.5
SEP-84	459	--
OCT-84	300	10.1
NOV-84	181	2.3
DEC-84	122	-1.1

The following weather data are applicable for the following sites: 122

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	186	-20.9
FEB-84	211	-7.3
MAR-84	469	-9.7
APR-84	604	6.4
MAY-84	639	8.0
JUN-84	551	15.7
JUL-84	687	18.5
AUG-84	569	19.9
SEP-84	372	9.3
OCT-84	201	6.7
NOV-84	163	-4.4
DEC-84	148	-16.7

The following weather data are applicable for the following sites: 395

Month	Total Monthly Solar Radiation on a Horizontal Service MJ/m2	Monthly Mean Temperature C
JAN-84	195	-12.1
FEB-84	241	-3.1
MAR-84	447	--
APR-84	485	6.9
MAY-84	534	9.7
JUN-84	763	16.8
JUL-84	660	18.6
AUG-84	577	19.2
SEP-84	395	11.9
OCT-84	278	9.1
NOV-84	152	1.6
DEC-84	106	-2.0